EBnet

Earth Observing System (EOS)
Data and Information System (EOSDIS)
Backbone Network (EBnet) AM-1
Review

May 9, 1996

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Agenda

I.	Introduction	8:00 - 8:20
II.	Requirements	8:20 - 9:20
	A. Requirements Overview	
	B. Traffic Requirements Management	
	C. Interface Requirements	
III.	EBnet Design	
	A. EBnet Topologies	9:20 - 9:50
	B R E A K	9:50 - 10:00
	B. Site Designs	10:00 - 11:00
	C. Implementation	
	D. Testing	
	E. Network Management System Design	
IV.	Operations Concepts	11:00 - 11:20
V.	NASA Networking Activities	11:20 - 11:50
VI.	Conclusion	11:50 - 12:00

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Board Members

- Bill Mack, Chair, Code 300
- John Lyon, Code 500
- Charles Cosner, TSDIS
- Ed Chang, AM-1
- Ed Cain, DISA
- Alex Krimchansky, EDOS
- Mike Rackley, FOS
- Mary Armstrong, ECS

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- Purpose
  - Provide details of the EBnet architecture and planned capabilities
  - Place supporting design phase documentation under configuration control
- Scope
  - EBnet readiness to support Landsat-7 and AM-1

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Success Criteria

- The following success criteria are addressed in detail within the Review Presentation Material:
  - Substantial evidence that the detailed design will meet performance, cost and schedule as planned
  - Bill of Materials developed to support design and circuit topology, including data transport and network management
  - Internal and external interfaces specified
  - Comprehensive test approach established; traceability analysis based on sound methodology
  - Acceptable operations concept has been developed
  - Adequate training planned and available to all appropriate resources
  - All significant implementation events, critical path, external dependencies, and risk mitigation plans in place have been considered

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Review Item Disposition (RID) Process

- All documentation and presentation material subject to Review Item Disposition process
- Use the RID form as supplied in hard-copy or on-line at the EBnet Home Page
- Transmit RIDs via electronic mail to BERGANSKIK@BAH.COM by 05/16/96
- Members of the EBnet staff will work with RID submitters

[Note that “COMMENT/CLARIFICATION FORMS” are located in the back of the auditorium; complete the form to submit a comment or to have one of our presenters contact you to elaborate on a point made during the presentation.]

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Overview of EBnet Reviews

- EBnet Status Briefing held in August 1995 provided a high level overview of the EBnet Project
  - Focused on high-level system requirements, roles and responsibilities
  - Management and technical approaches to implementation
- EBnet TRMM Review held in November 1995 to provided details of the EBnet architecture and planned capabilities, along with the status and schedule of work in progress
  - Focused on EBnet readiness to support TRMM
- EBnet AM-1 Review provides details of the EBnet topology and design, implementation and test plans, and operations concept
  - Focus is on EBnet continued support of TRMM and readiness to support Landsat-7 and AM-1
  - Changes in requirements, architecture, and operations concepts resulting from programmatic and budgetary considerations will be addressed

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RID and Action Item Update

- The EBnet Project responded to all RIDs and action items resulting from prior reviews
  - Twenty action items were received at the August 1995 Status Briefing; all twenty have been worked with appropriate organizations and are now closed
  - Two Level 1 and eleven Level 2 RIDs were submitted against the November 1995 EBnet TRMM Review; Project responses were distributed to RID submitters and to Review Board members

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Documentation Associated With This Review

- This Review will present information contained in the following documents:
  - Interface Control Documents (ICDs)
  - System/Acceptance Test Plan
  - Training Plan
  - System Implementation Plan
  - Operations Concept
- Documents, EBnet Traffic Database output, and presentation material can be accessed from the EBnet Home Page at:
  - http://skynet.gsfc.nasa.gov/EBNET/EBnet.html
- Security Documents underway but not placed on the Home Page due to sensitivity, including:
  - Security Test and Evaluation Plan
  - Risk Analysis
  - Risk Management Plan
  - Security Plan

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Introduction

- EBnet design represents current Project plans to support Landsat-7 and AM-1 as baselined at the ECS Release B CDR
- EBnet Traffic Database approach allows near real time network topology design and implementation modeling, and permits flexibility in responding to evolving network requirements
- EBnet is predicated on Commercial Off-the-shelf (COTS) Internet Protocol (IP) routers and Simple Network Management Protocol (SNMP) based network management software packages
- EBnet Modeling, Analysis, and Testbed (EMAT) lab established early on to evaluate product performance, perform quality workmanship inspections, and develop equipment configuration scenarios in order to identify candidate hardware and software
- EBnet Project will use existing procurement vehicles available to NASA Communications (Nascom) to implement, operate, and maintain EBnet

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Introduction (Cont'd)

- Innovative procurement alternatives evaluated:
  - Scientific and Engineering Workstation Package (SEWP) procurement vehicle already in place; viable contract vehicle accommodates "just in time" upgrades and phased bandwidth enhancements characterized by EBnet design
  - Nascom is currently working with AT&T (the Federal Telecommunications System (FTS) 2000 Network A service provider) to develop a contract modification known as Network Service Assurance Plan (NSAP)-II
    - NSAP-II will accommodate procurement of communications services to meet performance and customer interface requirements for high rate circuits, and will allow Nascom to procure engineering, operations, and maintenance of those services
  - Parallel implementation approach underway to eliminate any risk
- EBnet router-based design and COTS Bill of Materials imposes low technical risk regardless of ultimate procurement and implementation vehicles

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Introduction (Cont'd)

- EBnet requirements for TRMM, Landsat-7, and AM-1 provided through multiple sources
- NASA Communications (Nascom) evolving toward one physical IP network which will carry all IP traffic
  - EBnet is viewed as a "logical" network of EOSDIS Internal Network Requirements
  - Nascom IP Transition Conference held April 11-12
  - Nascom active participant in the NASA Networks Consolidation effort led by MSFC, includes Ames Research Center (ARC) network (NSI)

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Requirements Overview

- EBnet Requirements
- Requirement Changes Since TRMM Review
- Recommended Requirement Changes
- TRMM Review Requirement Issues Resolution

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EBnet Requirements

- EBnet requirements documented in the ESDIS Level 2 Requirements, Volume 6, EBnet Requirements (505-10-01-6). This document:
  - Uses Execution Phase Project Plan for EOS, Revision A and ESDIS Level 2, Volume 0, Overall ESDIS Project Requirements as sources
  - Appendix D, Volume 0 and Ad Hoc Working Group on Production (AHWGP) major sources for EBnet Traffic Database
  - Baselined by ESDIS in December 1995
- EBnet project will use the EBnet Requirements Document and EBnet Traffic Database to develop the design and verify requirements
- EBnet Requirements Document will support the activities of both ESDIS and EBnet projects. ESDIS has concurred to the approach of using a Design Package to document the level 3 design

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Baselined Requirement Changes Since TRMM Review

- Added the following requirements:
  - REQID EB2275: Operational availability of 0.999 and Mean Down Time (MDT) of 2 hours or less between Landsat Processing System (LPS) and the EOSDIS Core System (ECS)
  - REQID EB2276: Switchover time of 15 minutes or less from the primary interface between the LPS and EOSDIS
- Changed the following requirements:
  - REQID EB3070: EBnet contribution for real-time operations loop delay of no more than 0.75 seconds
  - REQID EB4110: Adding that EBnet shall provide the interface equipment between LPS and ECS and provide switchable backup
- Deleted Requirements
  - No requirements have been deleted since the TRMM Review

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Recommended Requirement Changes

- Change the following requirements:
  - REQID EB2110: EBnet shall provide a level of service where less than 0.05 percent of all packets are dropped due to errors for both real time and science data.
  - REQID EB2240: EBnet shall have an operational availability of 0.9998 as a minimum for forward and return real-time data communication exclusive of support to EOSDIS Ground Stations at Alaska and Norway.
  - REQID EB2250: EBnet shall have a Mean Time To Restore Service (MTTRS) of 1 minute or less for forward and return real-time data communication exclusive of support to EOSDIS Ground Stations at Alaska and Norway.
- Add the following requirements:
  - REQID EB2251: EBnet shall have an operational availability of 0.98 as a minimum for forward and return real-time data communication in support of EOSDIS Ground Stations at Alaska and Norway.
  - REQID EB2252: EBnet shall have a Mean Time To Restore Service (MTTRS) of 4 hours or less for forward and return real-time data communication in support of EOSDIS Ground Stations at Alaska and Norway.

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TRMM Review
Requirement Issues Resolution

- EBnet will maintain a Bit Error Rate of 1x10-4 for packet size of ≤1,000 bits (TBR Number 1) and 1x10-3 for packet size of ≤ 10,000 bits (TBR Number 2)
  - Work-off Plan involved a study conducted on the existing Version 0 network. Packet error measurements were conducted for a week with the result that 0.042 percent of packets were errored. Revision to REQID EB2110 was recommended based on these results.
- EBnet, in combination with EDOS, shall have contribution to the overall real-time operations (command up acknowledge back) loop delay of no more than 2.5 seconds (TBR Number 3)
  - Work-off Plan addressed by ESDIS Requirements Issues Working Group; Requirement EB3070 revised based on final analysis.
- Support of Level 1 48 hour backlog requirement
  - Work-off Plan addressed by ESDIS Requirements Issues Working Group; no changes to the Level 2 EBnet Requirements Document and no impact to EBnet.

EBnet Traffic Requirements Overview

- Recent Events
- Methodology
- Traceability
- Analysis
- Traffic Model
- Configuration Control
- Summary

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Recent Events

- ESDIS / DSNO EBnet Traffic Requirements Review
  - First review held on 22 February 1996
  - Line-by-line review by DSNO and ECS found no significant discrepancies
  - Next review to be held in late May / early June
- Removal of MSFC ECS DAAC
  - Lightning Imaging Sensor (LIS) Science Computing Facility (SCF) traffic is not an EBnet requirement
    - LIS Level 0 will be carried on NOLAN
    - Other LIS SCF traffic will be carried on NSI
- Stabilization of EDOS RESHAPE
  - Single Level Zero Processing Facility (LZPF) / multiple Ground Station Interface Facility (GSIF) architecture
  - New ESDIS Level 2 Requirements, Volume 0, Appendix D
    - Formerly ‘Table 4’ in Volume 2

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Methodology

Traffic Requirement Sources (Raw Data Rates)

- Volume 0 Appendix D
- HIS Modeling
- AHWGP
- ICDs
- DMRs
- IRDs

New Sources May be Identified

Review Requirements with Customers

Analyze & Import Traffic

EBnet Traffic Database

Generate Outputs

- Traffic Summary Tables — **Used By EBnet Design Team (or to generate service requests to FTS-2000)**
- Inputs to DID-223 — **Provided to HITS for DID-223 publication**
- Traffic Listings — **Used to analyze and review requirements**

Database Contents

Raw Traffic
- Information Source
- Mission / Project
- Traffic Description or Instrument
- Start / End Milestones
- Raw Data Rate
- Source / Destination End Points
- Traffic Type

Traffic Model
- Overhead Factors
- Formulas
- Assumptions

EBnet Traffic
- Start / End Dates
- Design Data Rate
- Source / Destination Network Nodes
- Traffic Type
- Protocol

Create & Maintain Traffic Model
Apply to Raw Requirements

EBnet Traffic Requirement Traceability

- ADEOS:
  - Mission Requirements Request Update Memo, M. Traxler / JPL, 10/95
    - Addresses V0 network support requirements for ADEOS
- AM-1:
  - ESDIS Level 2 Requirements Document, Volume 0, Appendix D, 4/96
    - Traffic to, from, and between EDOS elements
  - EBnet ICDs (EOC, SAS, GSE, SCS, SDF, SMC, ETS, FSTB, and SSIM)
    - Only sources of some requirements for above systems
  - Ad Hoc Working Group on Production (AHWGP) Spreadsheets, 3/96
    - Inter-DAAC science products
  - ESDIS Level 2 Requirements Document, Volume 2, Table 4, 9/95
    - ASTER GDS traffic not in Volume 0, Appendix D
    - Operations management traffic not in Volume 0, Appendix D
- Landsat-7:
  - EOSDIS-Landsat-7 IRD, 7/95
    - Landsat Processing System traffic (at EDC campus)

EBnet Traffic Requirement Traceability

- METEOR / SAGE-III:
  - AHWGP Spreadsheets, 3/96
    - Inter-DAAC science products (GSFC DAAC to LaRC DAAC)
- TRMM:
  - TRMM-EOSDIS IRD DCN CH-01, 2/95
    - SDPF and TSDIS traffic to/from ECS
  - EBnet ICD with TSDIS
    - TRMM systems at GSFC
  - AHWGP Spreadsheets, 3/96
    - Inter-DAAC science products (GSFC DAAC to LaRC DAAC)
  - TRMM DMR, 6/94
    - ICD between SDPF and TRMM Consumers to be used for NASDA EOC traffic
- Mission Not Specified:
  - Communication Requirements for ECS Project, DID-220, 10/95
    - Inter-DAAC User Query and Query Response traffic
  - ECS-NOAA Ancillary Data Center ICD, 12/95
    - NOAA to LaRC ancillary data

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Requirements Timeline

Date	Customer Milestone
1/96	Start TRMM Pre-Launch
1/96	ECS Release IR1
8/96	ADEOS Launch
8/96	ECS Release A Implementation
8/96	LZPF - EOC Capability On-line
9/96	VFPA AM-1 Testing
1/97	EDOS GSIF at WSC and STGT/WSGTU to LZPF On-line
3/97	LZPF - DAAC Capability On-line
4/97	ASTER GDS On-line
5/97	ECS Release B Implementation
5/97	Landsat-7 Pre-Launch
8/97	TRMM Launch
3/98	AM-1 Relocates from VFPA to VAFB
5/98	Landsat-7 Launch
6/98	AM-1 Launch
8/98	Meteor/SAGE III Launch
1/99	Increase in Science Traffic Volume
6/2000	Initial Alaska and Norway testing
TBD	PM-1 Pre-Launch
12/2000	PM-1 Launch

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Analysis

- Objective: Obtain node-to-node data volumes
- Step One: Requirements Analysis
  - Data rate (or data volume and time to deliver)
  - Reliability / availability
    - One minute MTTRS
    - Four hour MTTRS
  - Timeframe
  - Protocol
  - Design on average or peak data rate
  - Mutually exclusive requirements
- Step Two: Application of the Traffic Model
  - Burden raw data rates with overhead factors

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Traffic Model

- Objective: Burden raw data rates with overhead factors to obtain design data rates
  - Circuit Utilization Factor (e.g., 1.25 to accommodate queuing theory limit)
  - Protocol Overheads
  - Retransmission Overhead
  - Contingency / Peaking Factors
  - Time Factors (e.g., 50/45 to transport 50 minutes of data in 45 minutes)
- Method
  - Derive modeling factors
    - Meetings with interfacing elements (e.g., EDOS, ECS, etc.)
    - Best engineering design practices
    - Empirical data (from testing)
  - Apply factors to traffic requirements
- Result: [Design Rate] = [Raw Rate] * [Overhead Factors]

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Configuration Management

- EOSDIS traffic requirements satisfied by the EBnet Project are controlled by established Code 540 CM procedures
- The EBnet Traffic Database is the repository for IP traffic requirements
- Changes to traffic requirements are effected by use of the Nascom Traffic Requirement Configuration Change Request (CCR) form
- Nascom/EBnet staff are responsible for interfacing with customers regarding new or modified traffic requirements and subsequently sponsor a CCR
- CCRs are reviewed and approved by appropriate Nascom management
- Overhead modeling factors and algorithms are also maintained under configuration control

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Summary

- EBnet Project has a solid grasp of EOSDIS traffic requirements
- ESDIS is working to improve traceability requirements sources:
  - ADEOS: contents of Traxler memo to be placed in appropriate document
  - AHWGP and HITS ECS Modeling: outputs may be formally controlled
  - TRMM: incorporate NASDA traffic in SDPF-TRMM Consumer ICD
  - EDOS: ICDs are under development
  - ECS SMC: operations concept is under development
- EBnet will utilize new and improved requirements sources as they become available
- Traffic Requirements Listing:
  - Available on WWW at http://skynet.gsfc.nasa.gov/EBNET/EBnet.html/

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Overview

- Release A
  - TRMM Operations
  - AM1 and Landsat Testing
- Realtime Ops
- EOC Phase I Support
- EOC Phase II Support
- Release B (and beyond)

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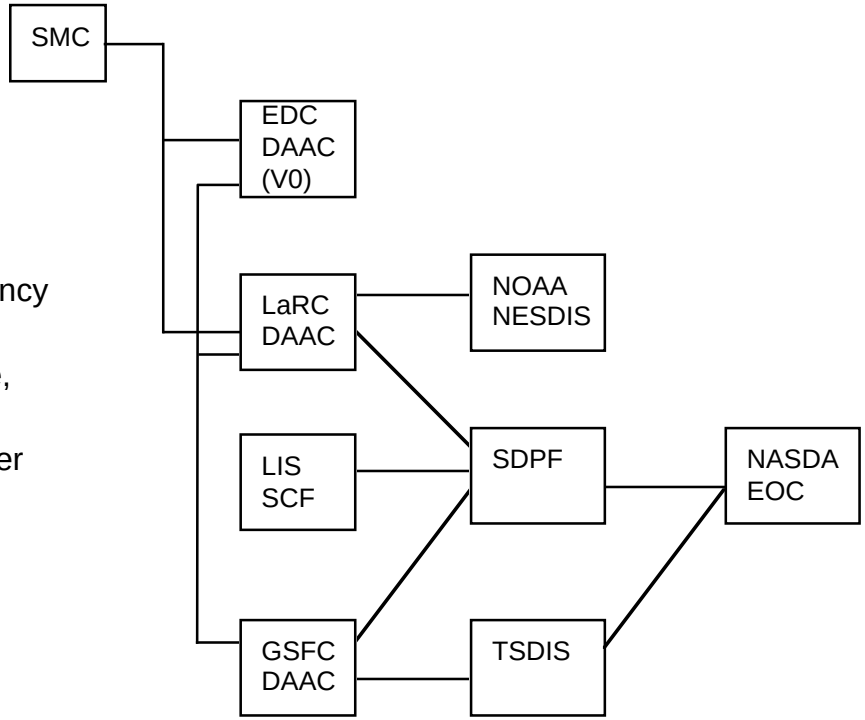
EBnet Interfaces for Release A Support

- DAAC - Distributed Active Archive System
- LIS SCF - Lightning Imaging Sensor Science Computing Facility)
- NASDA EOC - National Space Development Agency (of Japan) Earth Observation Center
- NOAA NESDIS - National Environmental Satellite, Data and Information Service
- SMC - System Monitoring and Coordination Center
- TSDIS - TRMM Science Data and Information System



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System Acronym List

- ASTER GDS - Advanced Spaceborne Thermal Emission Radiometer Ground Data System (ERSDAC)
- DAAC - Distributed Active Archive System (Hughes - ECS)
- EDOS GSIF - EOS Data and Operations System Ground Station Interface (TRW - EDOS)
- EDOS LZPF - EOS Data and Operations System Level Zero Processing Facility (TRW - EDOS)
- EOC - EOS Operations Center (Hughes - ECS)
- EOP (V2) - EDOS Operational Prototype (Version 2) (TRW - EDOS)
- ETS LRS - EOSDIS Test System Low Rate System (Code 515)
- ETS MPS - EOSDIS Test System Multimode Portable Simulator (Code 515)
- FDF - Flight Dynamics Facility (Code 550)
- IST - Instrument Support Terminal (Hughes - ECS)
- LIS SCF - Lightning Imaging Sensor Science Computing Facility (MSFC)
- LPS - Landsat Processing System (Code 510)
- NASDA EOC - National Space Development Agency (of Japan) Earth Observation Center (NASDA)
- NCC - Network Control Center (Code 530)
- NESDIS - National Environmental Satellite, Data and Information Service (NOAA)
- SCS - Spacecraft Checkout Station (Lockheed Martin)
- SMC - System Monitoring and Coordination Center (Hughes - ECS)
- SDF - Software Development Facility (Lockheed Martin)
- SDPF - Science Data Processing Facility (Code 510)
- SSIM - Spacecraft Simulator (Lockheed Martin)
- TGT - TDRSS Ground Terminal (Code 530)
- TSDIS - TRMM Science Data and Information System (Code 902)

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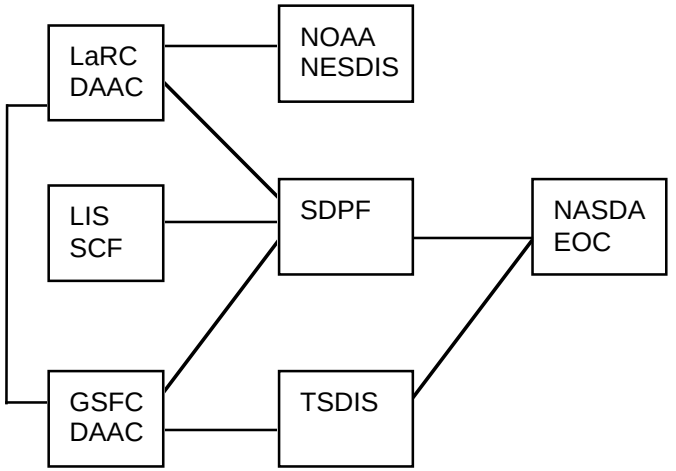
Science Data (TRMM operations)

- DAAC - Distributed Active Archive System
- GSFC - Goddard Spaceflight Center
- LaRC - Langley Research Center
- LIS SCF - Lightning Imaging Sensor Science Computing Facility
- NASDA EOC - National Space Development Agency (of Japan) Earth Observation Center
- NOAA NESDIS - National Oceanographic and Atmospheric Administration National Environmental Satellite, Data and Information Service
- SDPF - Science Data Processing Facility
- TSDIS - TRMM Science Data and Information System



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Science Data (TRMM operations) Interface Description

System	Location	Need date*	Data rate
GSFC DAAC	Bldg 32	8/96	to TSDIS: 2 Mbps to LaRC DAAC: 3 Kbps
LaRC DAAC	LaRC	8/96	
LIS SCF	MSFC	8/96	
NASDA EOC	Japan	In Place	
NESDIS	Suitland MD	In Place	to LaRC DAAC: 495 Kbps
SDPF	Bldg 23	In Place	to LaRC DAAC: 25 Kbps to TSDIS: 716 Kbps to LIS SCF: 55 Kbps to NASDA EOC: 359 Kbps
TSDIS	Bldg 32	In Place	to GSFC DAAC: 18 Mbps

*ECS need date for Release A

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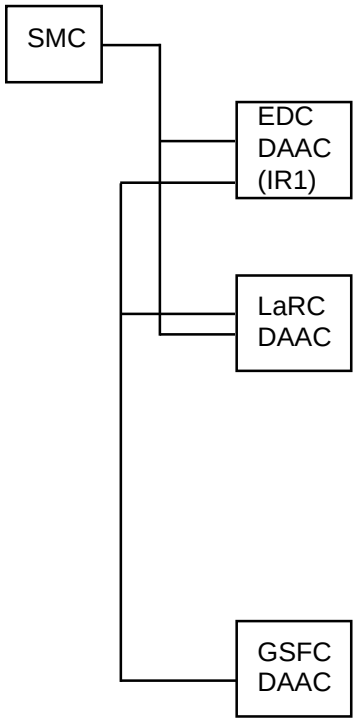
Science Data (AM1 and Landsat testing)

- DAAC - Distributed Active Archive System
- EDC - Earth Resources Observation System (EROS) Data Center
- GSFC - Goddard Spaceflight Center
- LaRC - Langley Research Center
- SMC - System Monitoring and Coordination Center



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Science Data (AM1 and Landsat testing) Interface Description

System	Location	Need date*	Data Rate
GSFC DAAC	Bldg 32	7/96	to SMC: 512 Kbps (TBR)
LaRC DAAC	LaRC	7/96	to SMC: 512 Kbps (TBR)
EDC DAAC (V0)	EDC	7/96	to SMC: 512 Kbps (TBR)
SMC	Bldg 32	7/96	to DAACs: 64 Kbps (TBR)

* ECS need date for Release A

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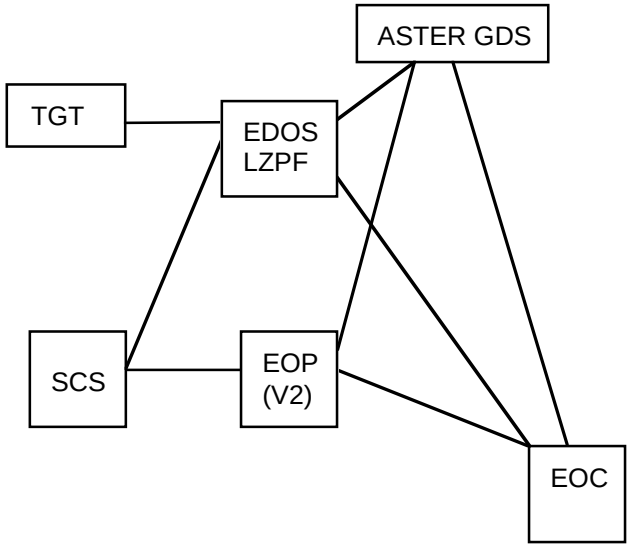
Realtime Ops (AM1 testing)



- ASTER GDS - Advanced Spaceborne Thermal Emission Radiometer Ground Data System
- EDOS LZPF - EOS Data and Operations System Level Zero Processing Facility
- EOC - EOS Operations Center
- EOP (V2) - EDOS Operational Prototype (Version 2)
- SCS - Spacecraft Checkout Station
- TGT - TDRSS Ground Terminal

EBnet Realtime Ops Interface Description

System	Location	Need date	Data rate
EOC	Bldg 32	8/96	to EDOS LZPF: 17 Kbps RT to EDOS LZPF: 119 Kbps other
SCS	Valley Forge, PA (VAFB)	8/96 (3/98)	to EDOS LZPF/EOP (V2): 1, 16, or 256 Kbps (c/d)
EOP* (V2)	Bldg 32	9/96	(same as EDOS LZPF)
EDOS LZPF	Bldg 32	1/97	to EOC: 42 Kbps RT to EOC: 1.5 Mbps RB to ASTER GDS: 42 Kbps RT to ASTER GDS: 42 Kbps RB to SCS: 0.125, 1, 2, or 10 Kbps (real time c/d) to TGT: 0.125, 1, 2, or 10 Kbps (real time c/d)
TGT	WSC	1/97	to EDOS LZPF: 1, 16, or 256 Kbps (c/d)
ASTER GDS	Tokyo, Japan	4/97	to EOC: TBD to DAACs: TBD to IST-US (JPL): TBD

*EOP and EDOS LZPF are assumed to be mutually exclusive

Note: c/d = clock and data

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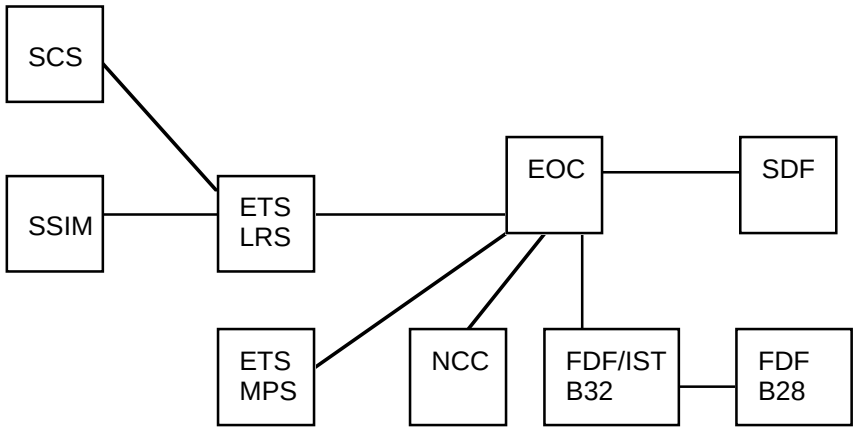
EOC Phase I Support

- EOC - EOS Operations Center
- ETS LRS - EOS Test System Low Rate System
- ETS MPS - EOS Test System Multimode Portable Simulator
- FDF - Flight Dynamics Facility
- IST - Instrument Support Terminal
- NCC - Network Control Center
- SCS - Spacecraft Checkout Station
- SDF - Software Development Facility
- SSIM - Spacecraft Simulator



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EOC Phase I Support Interface Description

System	Location	Need date	Data Rate
EOC	Bldg 32	8/96	to FDF: 1 Mbps to NCC: 119 Kbps to ETS LRS: (same as EDOS LZPF) to ETS MPS: (same as EDOS LZPF)
NCC	Bldg 13	8/96	to EOC: 476 Kbps
SCS*	Valley Forge, PA	9/96	to ETS LRS: (same as EDOS LZPF)
SDF	Valley Forge, PA	8/96	to EOC: 512 Kbps
ETS HRS	Bldg 32	10/96	to EDOS: 34 Mbps to DAAC: 34 Mbps
ETS LRS	Bldg 25 Bldg 32	8/96 9/96	to EOC: (same as EDOS LZPF) to SCS: (same as EDOS LZPF) to SSIM: (same as EDOS LZPF)
ETS MPS	Bldg 25 Bldg 32	7/96 10/96	to EOC: (same as EDOS LZPF)
SSIM*	Valley Forge, PA	1/97	to ETS LRS: (same as EDOS LZPF)
FDF	Bldg 32 Bldg 28	TBD	to EOC: 1 Mbps to FDF: 512 Kbps (TBR)

*SSIM and SCS are assumed to be mutually exclusive

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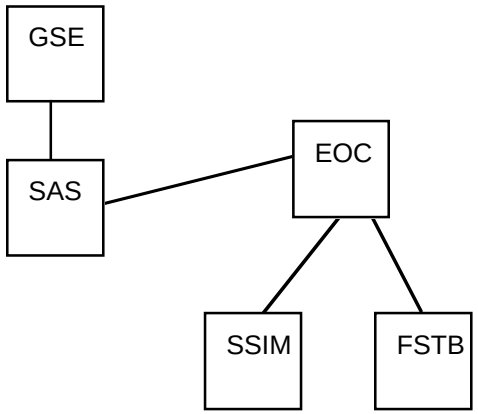
EOC Phase II Support



- EOC - EOS Operations Center
- FSTB - Flight Software Testbed
- GSE - Ground Support Equipment
- SAS - Spacecraft Analysis System
- SSIM - Spacecraft Simulator

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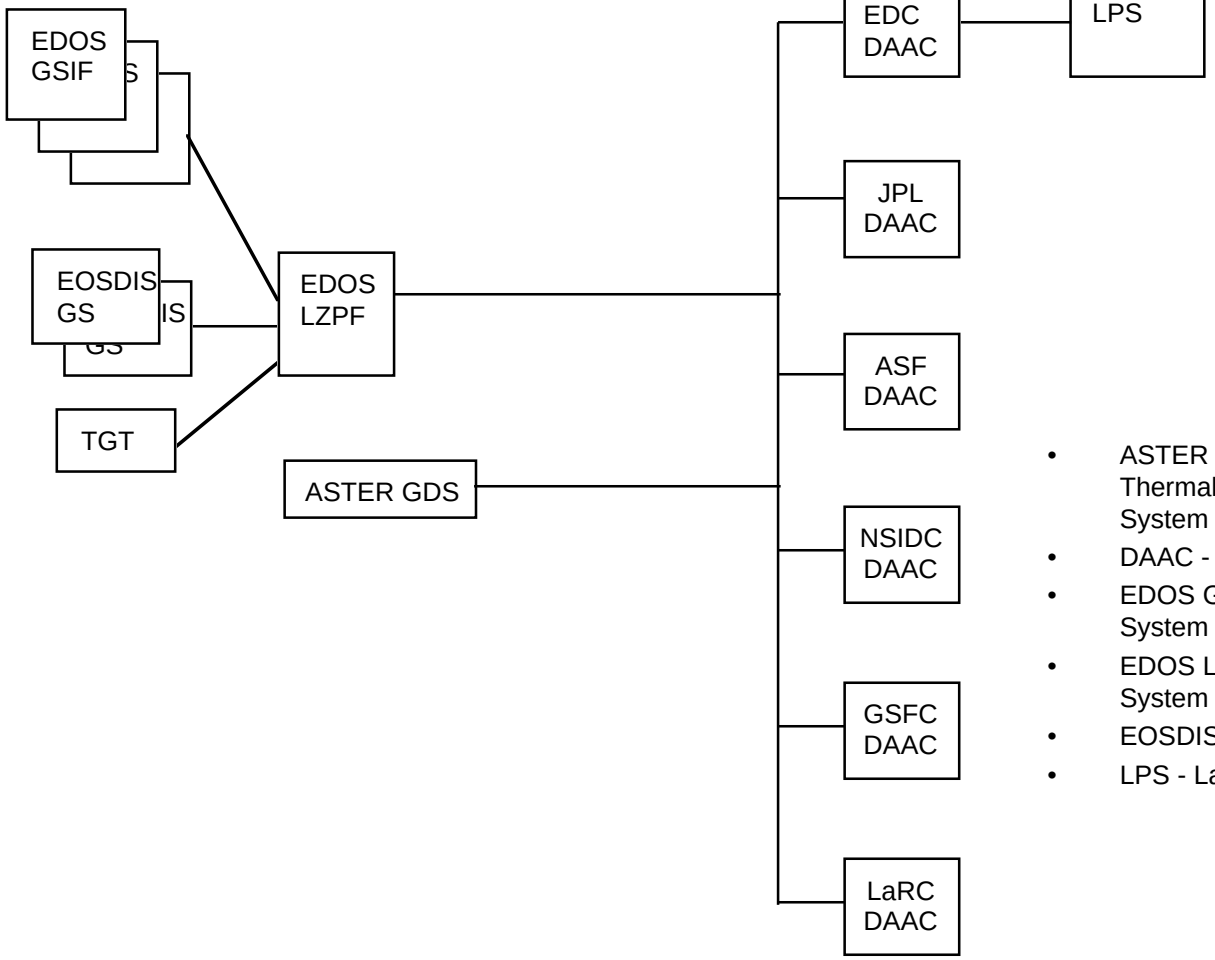
EOC Phase II Support Interface Description

System	Location	Need date	Data Rate
SSIM	Bldg 32	6/97	to EOC: 512 Kbps
FSTB	Bldg 1	12/97	to EOC: 56 Kbps
SAS	Bldg 32	12/97	to EOC: 512 Kbps
GSE	Valley Forge, PA	launch	to SAS: 56 Kbps

Note: GSE requirements are currently under study by AM-1 project.

EBnet Release B (and beyond) Interfaces



- ASTER GDS - Advanced Spaceborne Thermal Emission Radiometer Ground Data System
- DAAC - Distributed Active Archive System
- EDOS GSIF - EOS Data and Operations System Ground Station Interface
- EDOS LZPF - EOS Data and Operations System Level Zero Proccessing Facility
- EOSDIS GS - EOSDIS Ground Station
- LPS - Landsat Processing System

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Release B Interface Description (1/2)

System	Location	Need date*	Data Rate
ASF DAAC	ASF	5/97	to Other DAACs: 5 Kbps
EDC DAAC	EDC	5/97	to GSFC DAAC: 779 Kbps to Other DAACs: 5 Kbps
GSFC DAAC	B32	5/97	to ASF DAAC: 1 Kbps to EDC DAAC: 10 Mbps to LaRC DAAC: 20 Mbps to JPL DAAC: 18 Kbps to NSIDC DAAC: 154 Kbps
JPL DAAC	JPL	5/97	to Other DAACs: 5 Kbps
LaRC DAAC	LaRC	5/97	to EDC DAAC: 565 Kbps to Other DAACs: 10 Kbps
NSIDC DAAC	NSIDC	5/97	to EDC DAAC: 268 Kbps to Other DAACs: 1 Kbps

*ECS Need dates are for Release B

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Release B Interface Description (2/2)

System	Location	Need date	Data Rate
EDOS GSIF	WSC	1/97	to EDOS LZPF: 31 Mbps (science c/d)
EDOS LZPF	Bldg 32	1/97	to EOSDIS GS: 0.125, 1, 2, 10 Kbps (realtime c/d) to GSFC DAAC: 13 Mbps to LaRC DAAC: 7 Mbps
ASTER GDS	Tokyo, Japan	4/97	to DAACs: TBD Kbps
LPS	EDC	5/97	to EDC DAAC: 85 Mbps
EOSDIS GS	Spitzbergen, Norway Fairbanks, Alaska	6/00	to EDOS LZPF: 1, 16, 512 Kbps (realtime c/d)
EDOS GSIF	Spitzbergen, Norway Fairbanks, Alaska	6/00	to EDOS LZPF: 31 Mbps (science c/d)

EBnet

Overview

- Topology Update
- Implementation Strategy
- Requirements Timeline
- V0 Network
- EBnet Supporting TRMM & Release A
- EBnet 1/97 Supporting EDOS
- EBnet 5/97 Release B
- EBnet 3/98 Relocate to Launch Facility
- EBnet 1/99 Increased Inter-DAAC Traffic
- EBnet 6/00 High Latitude

EBnet

Topology Update

- Topologies reflect Reshape Architecture
  - EDOS LZPF at GSFC, ground terminal at WSC
  - Clock & Data circuits from WSC to GSFC, IP otherwise
- Real-Time Network
  - One-minute Mean Time To Restore Service (MTTRS)
  - Availability 0.9998, redundant equipment and circuits
  - Three locations, WSC, GSFC, and Japan
  - Alaska & Norway not included
- IP Science Network
  - Four-hour MTTRS, no redundancy
  - Availability 0.98
  - IP data network except for 31 Mbps WSC link

EBnet

Implementation

- Science Network developed from V0 Network
  - Nascom replacing Program Support Communications Network (PSCN) circuits with Federal Telecommunications System (FTS) 2000 circuits
  - FTS 2000 available circuits: 64K, Fractional T1, T1, T3
- EBnet and V0 networks use channelized circuits
  - Maintains EBnet traffic priority
  - Security, isolates EBnet from V0 campus networks & Internet
- Circuit phase-in approach
  - Add bandwidth as needed

EBnet

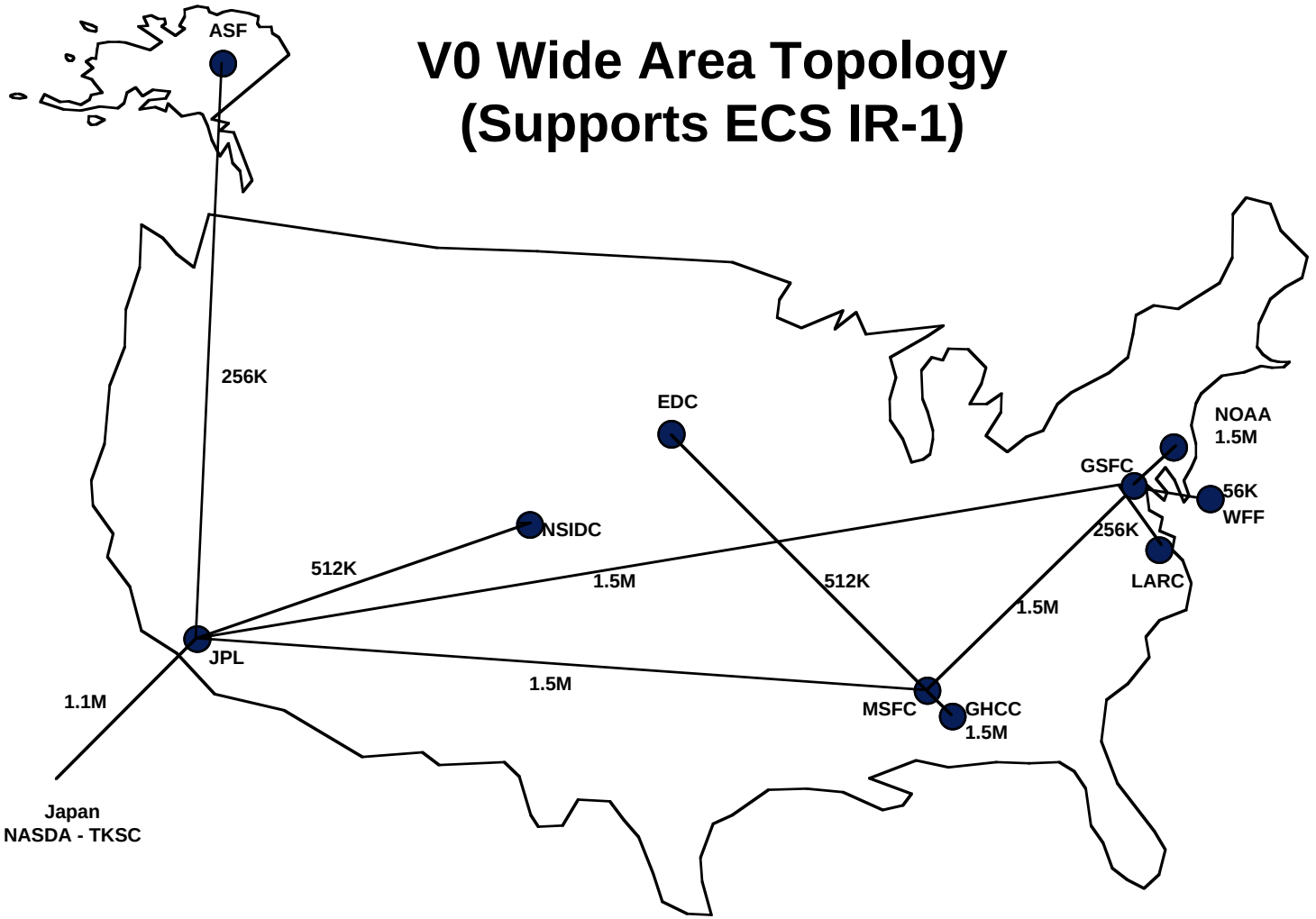
Requirements Timeline

Date	Customer Milestone	Internet Protocol	Clock & Data
1/96	TRMM Pre-Launch	X	
1/96	ECS Release IR1	X	
8/96	ADEOS Launch	X	
*8/96	ECS Release A Implementation	X	
*9/96	VFPA AM-1 Testing		X
*1/97	EDOS at WSC Implementation	X	X
*3/97	EDOS to DAAC Testing	X	
*5/97	ECS Release B & Landsat 7 Implementation	X	
8/97	TRMM Launch	X	
*3/98	AM-1 relocates from VFPA to VAFB		X
5/98	Landsat-7 Launch	X	
6/98	AM-1 Launch	X	X
8/98	Meteor/SAGE III Launch	X	
*1/99	Increase in science traffic volume	X	
*6/00	Initial Alaska and Norway testing	X	X

* requires change in EBnet topology

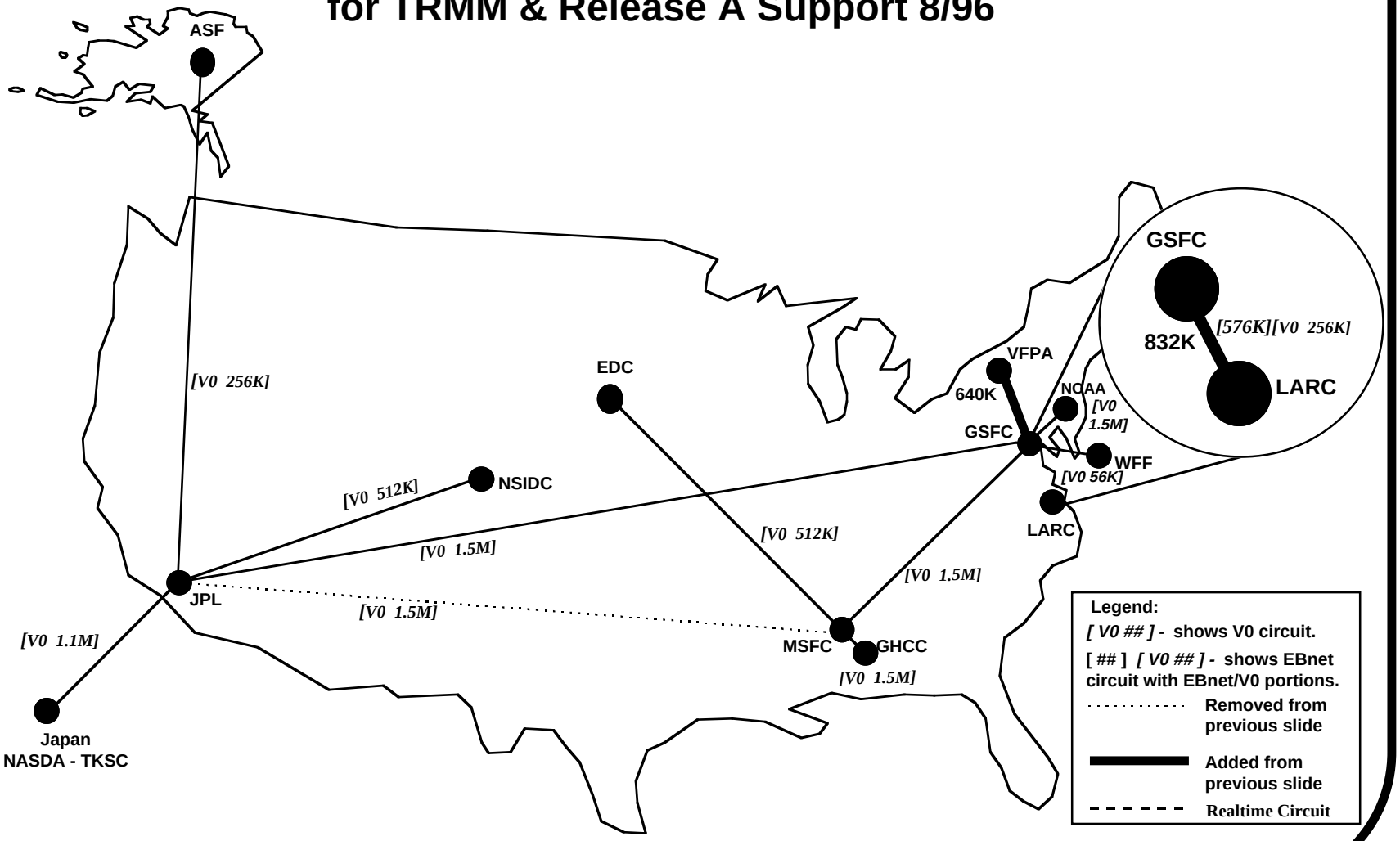
EBnet

V0 Wide Area Topology
(Supports ECS IR-1)



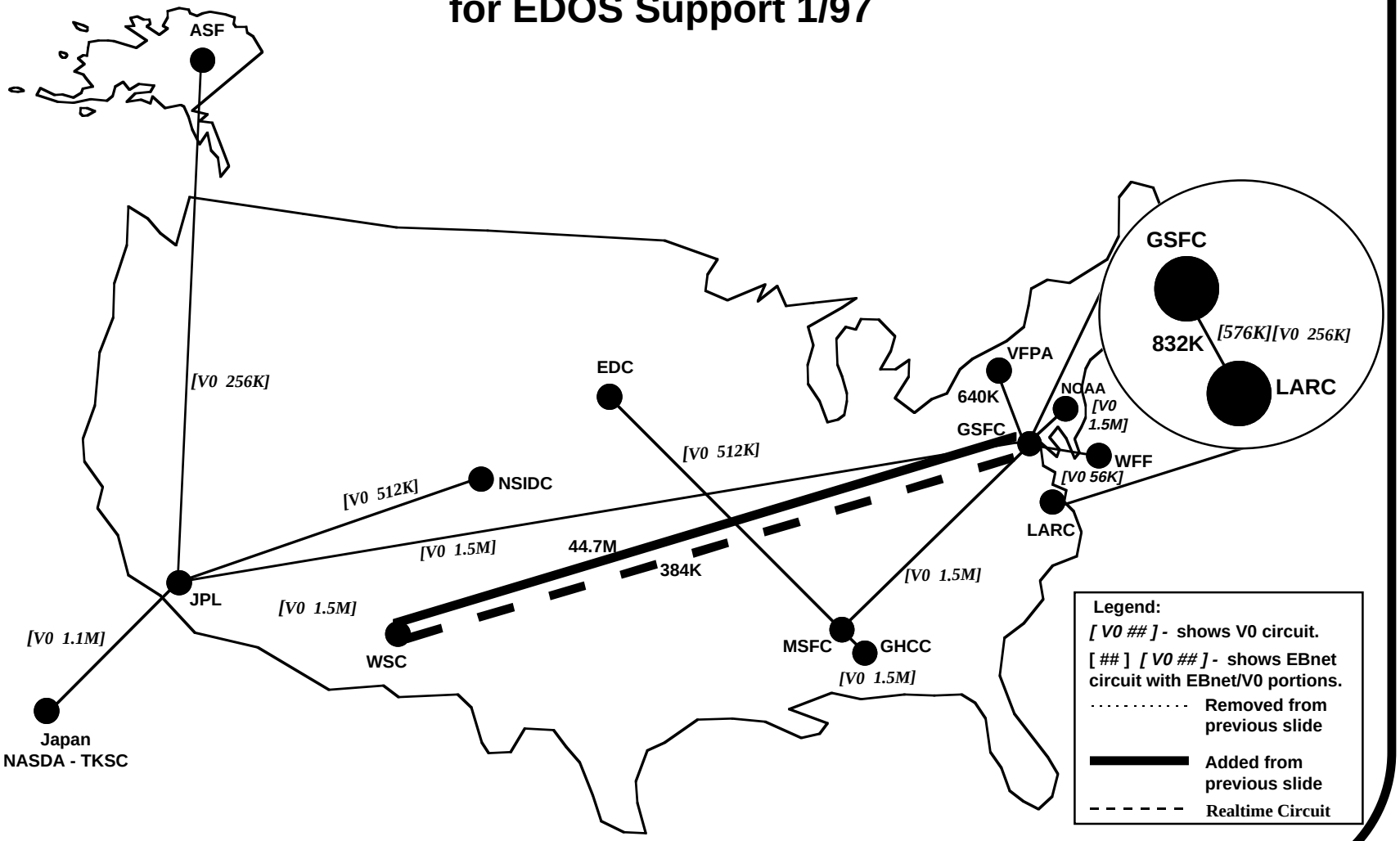
EBnet

EBnet Wide Area Network Topology for TRMM & Release A Support 8/96



EBnet

EBnet Wide Area Network Topology for EDOS Support 1/97



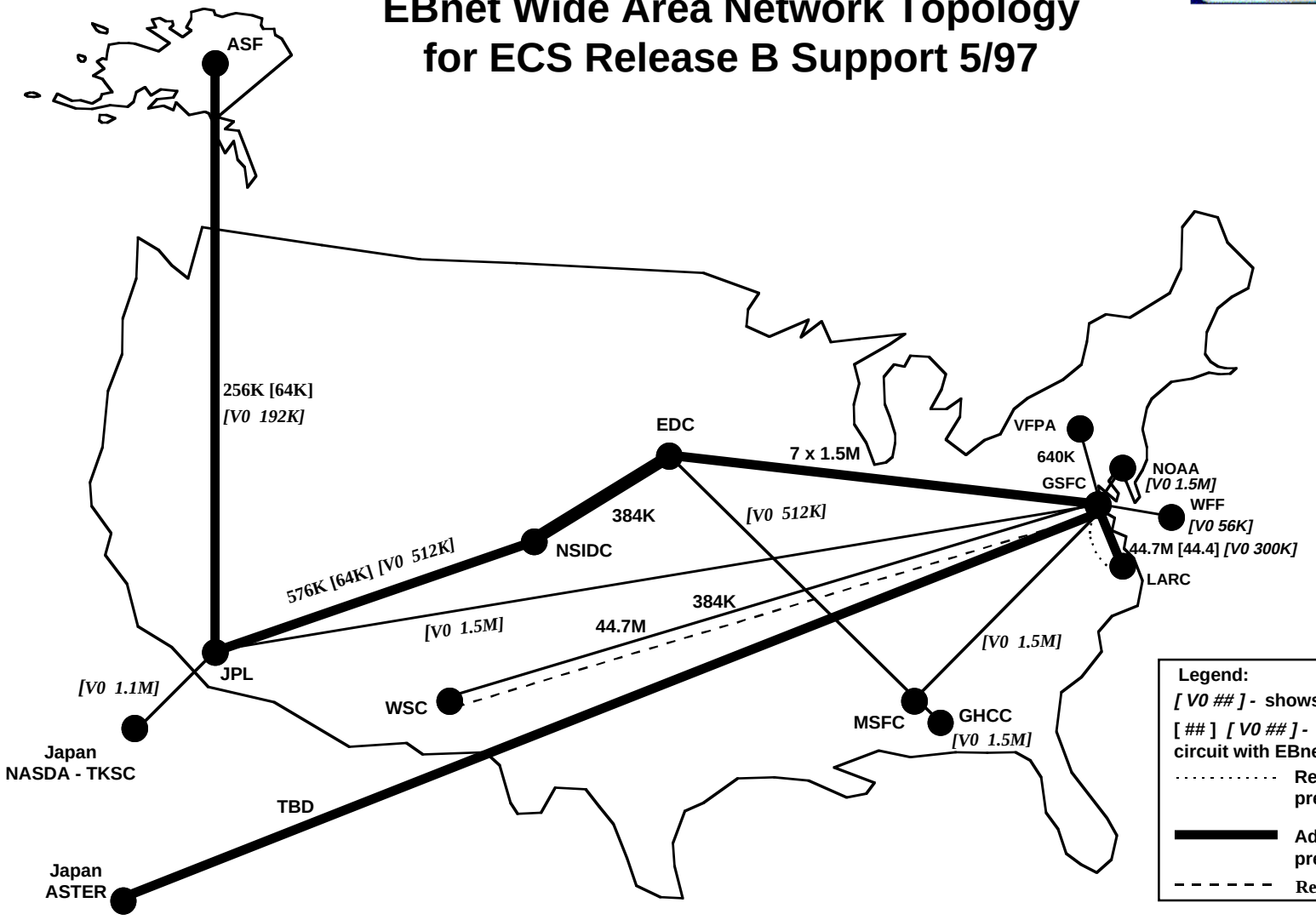
EBnet

Release B Installs

Site	ECS Install Date	BW at ECS Install	Final BW 5/97
LaRC	1/16 - 1/30/97	576K	T3 (3/97)
EDC	1/30 - 2/13/97	T1	7 x T1s
NSIDC	2/13 - 2/22/97	384K, 576K	same
JPL	3/4 - 3/12/97	256K, 576K	same
ASF	3/20 - 3/26/97	256K	same

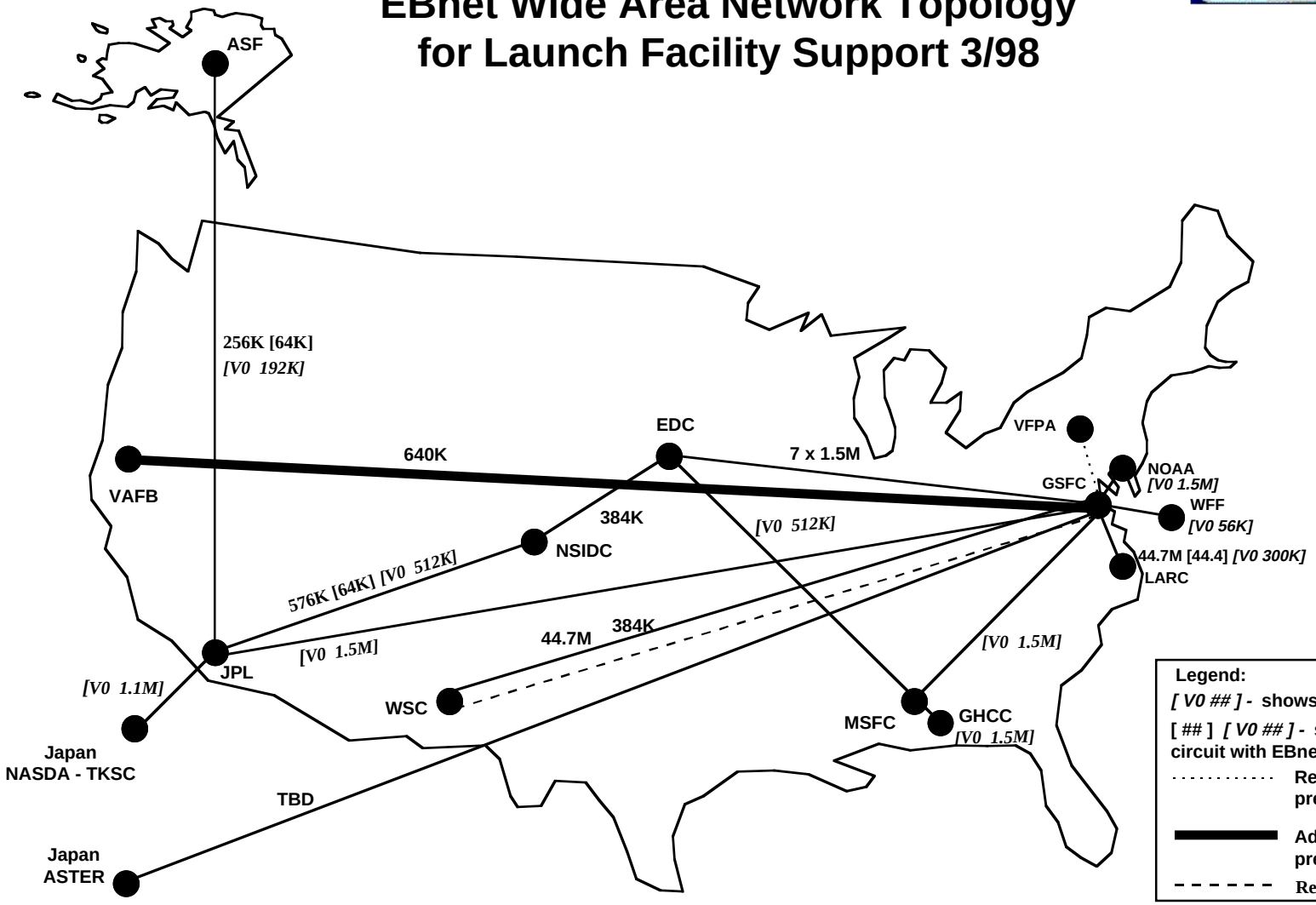
EBnet

EBnet Wide Area Network Topology for ECS Release B Support 5/97



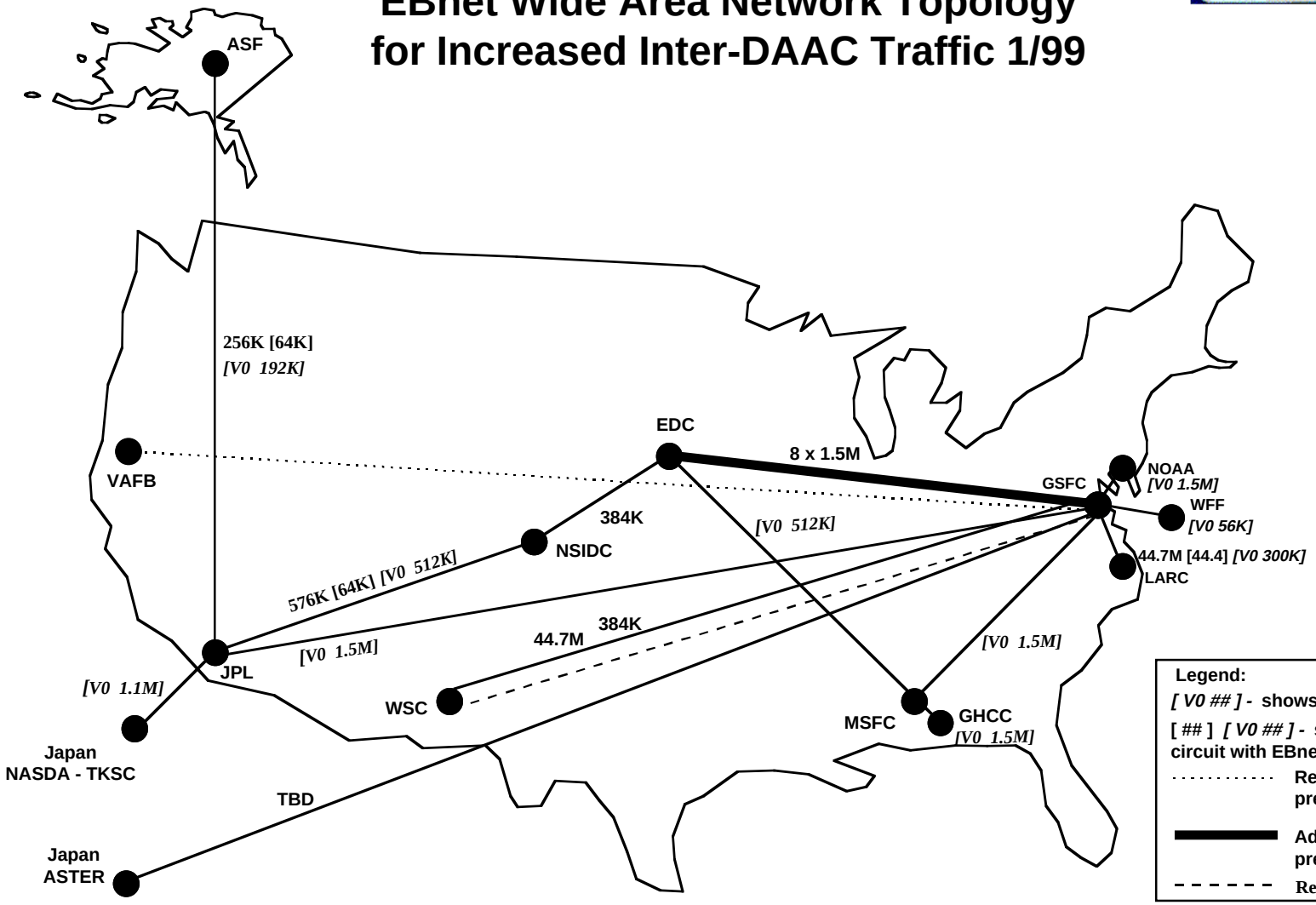
EBnet

EBnet Wide Area Network Topology for Launch Facility Support 3/98



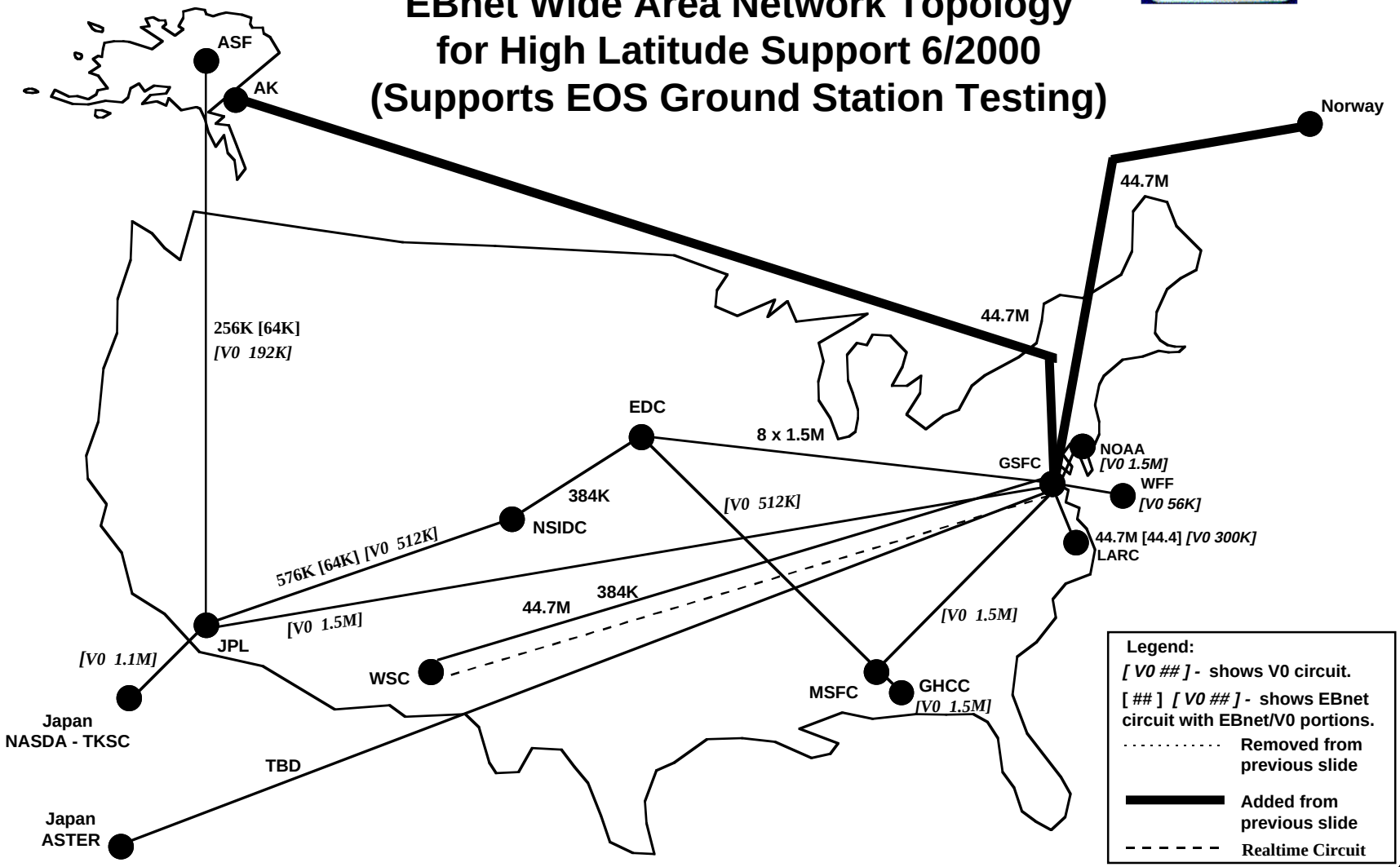
EBnet

EBnet Wide Area Network Topology for Increased Inter-DAAC Traffic 1/99



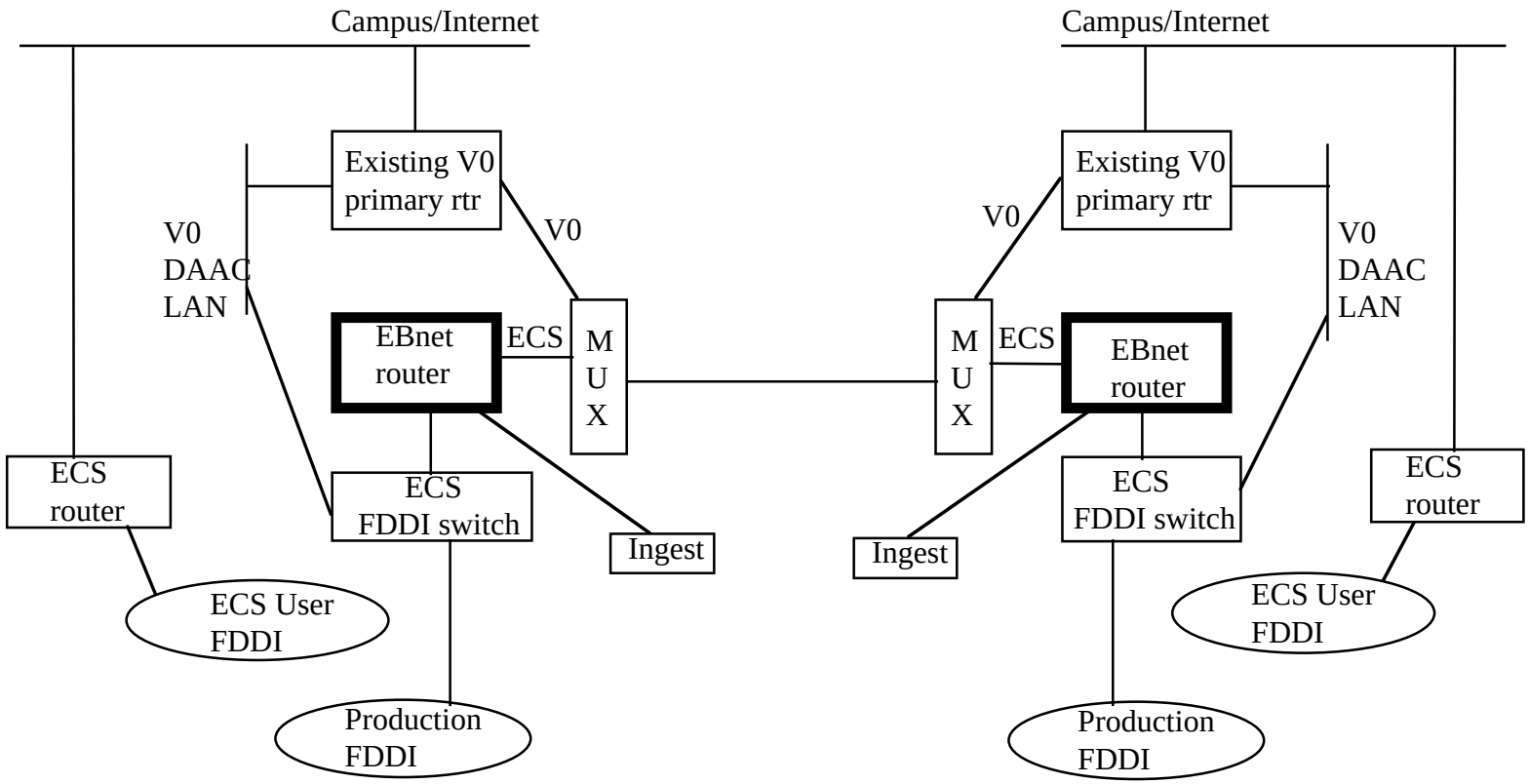
EBnet

EBnet Wide Area Network Topology for High Latitude Support 6/2000 (Supports EOS Ground Station Testing)



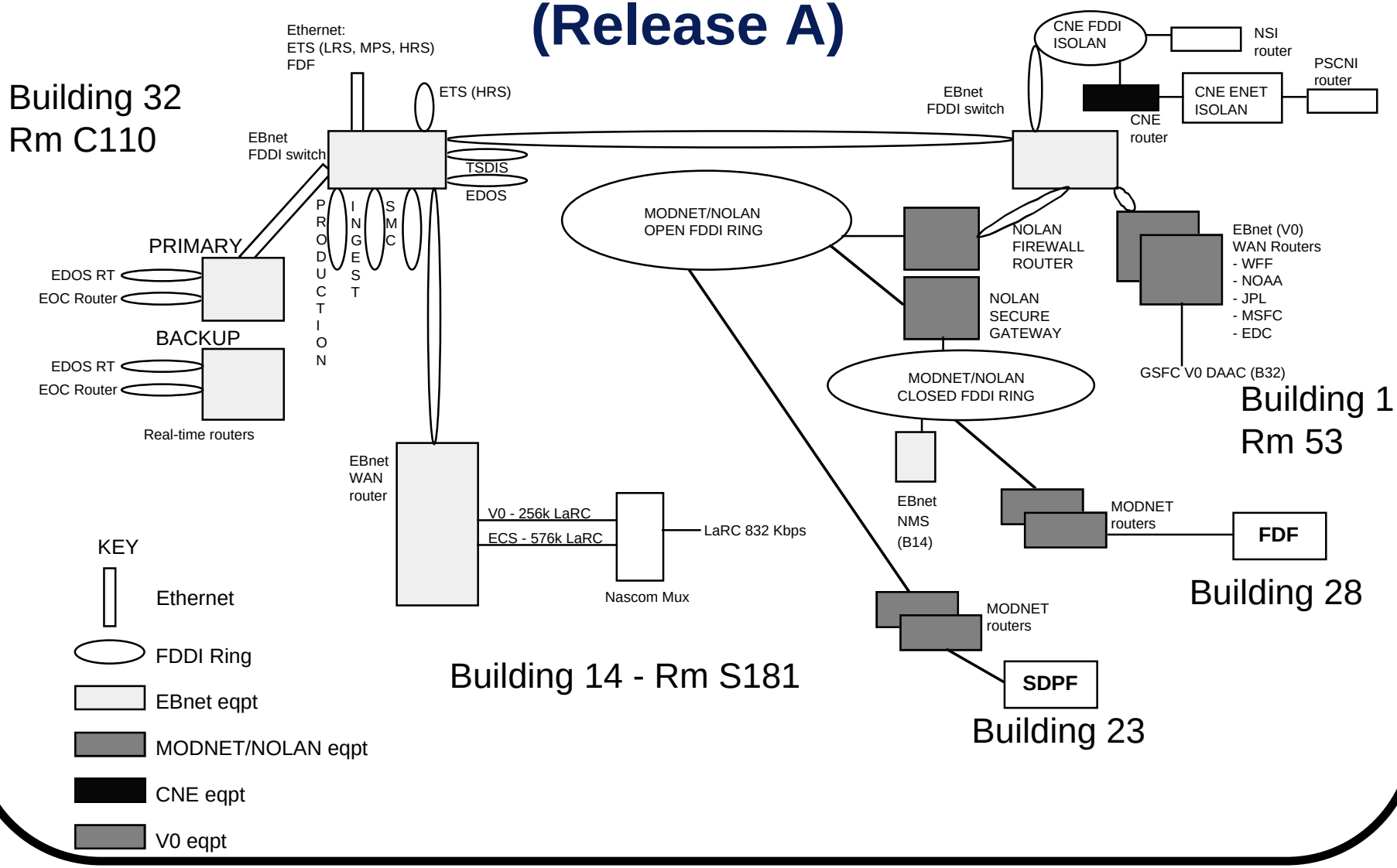
EBnet

Generic EBnet Site Design



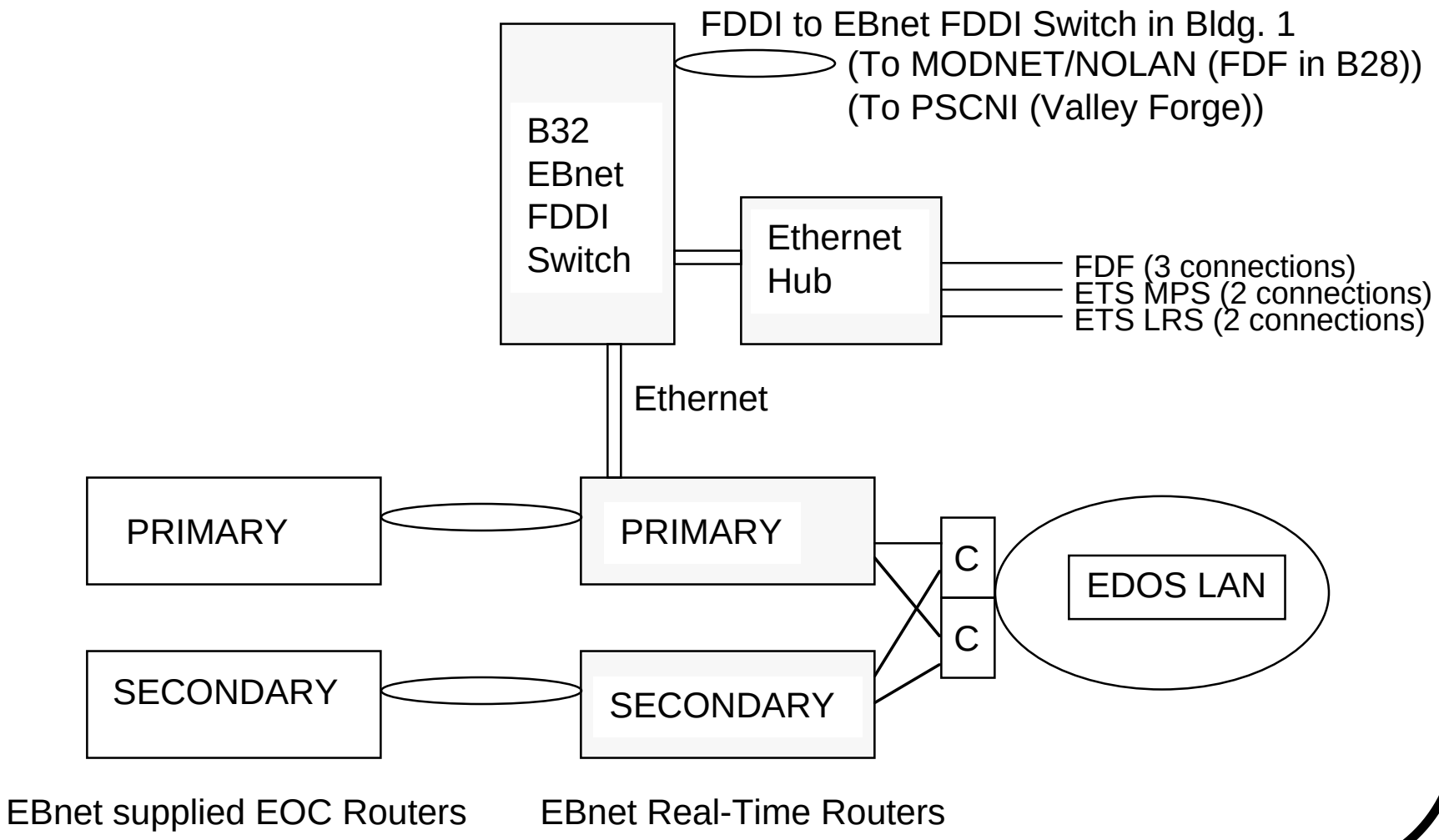
EBnet

GSFC Site Design for TRMM Support (Release A)



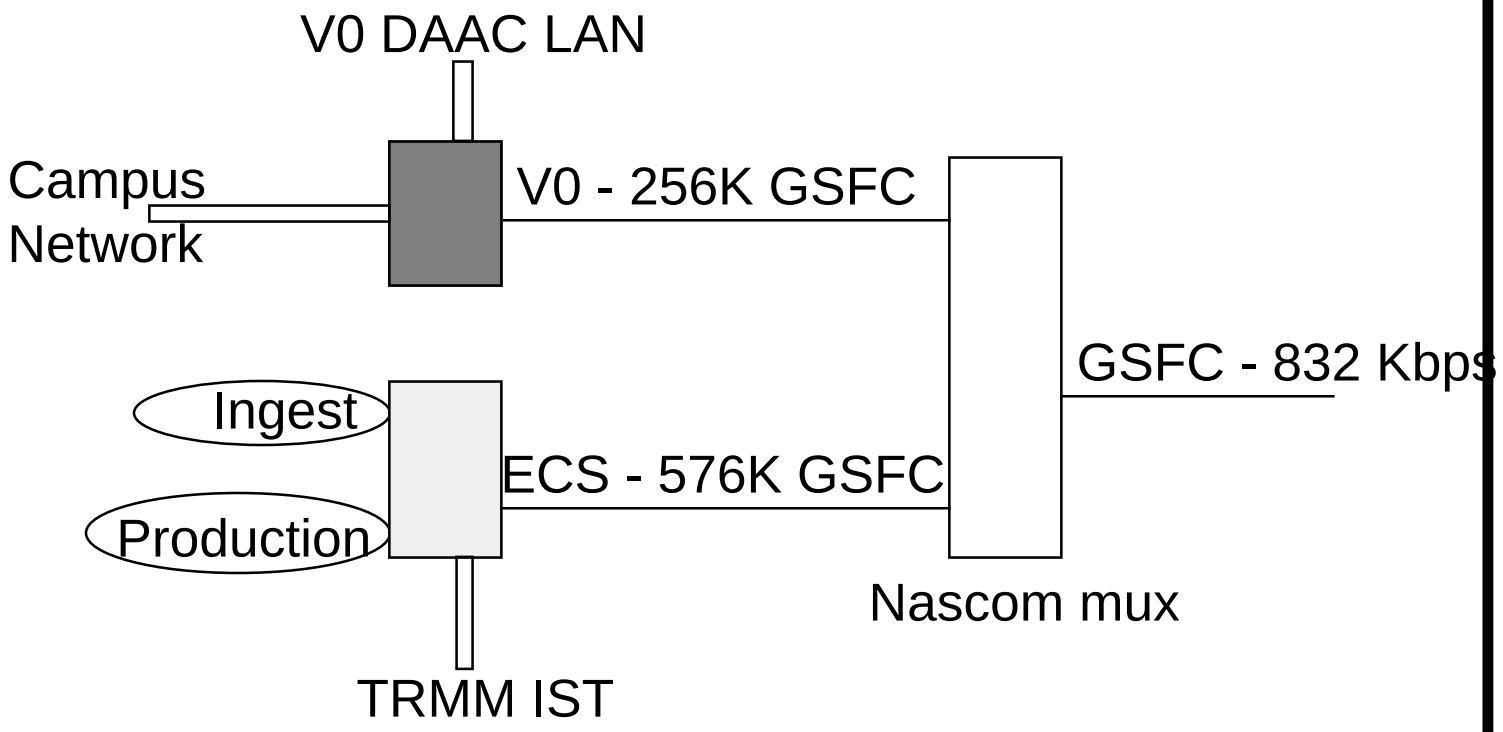
EBnet

EOC Interface Design for Phase I



EBnet

LaRC Release A Design



EBnet Interfaces:
FDDI - ECS Ingest
FDDI - ECS Production
Ethernet - TRMM IST

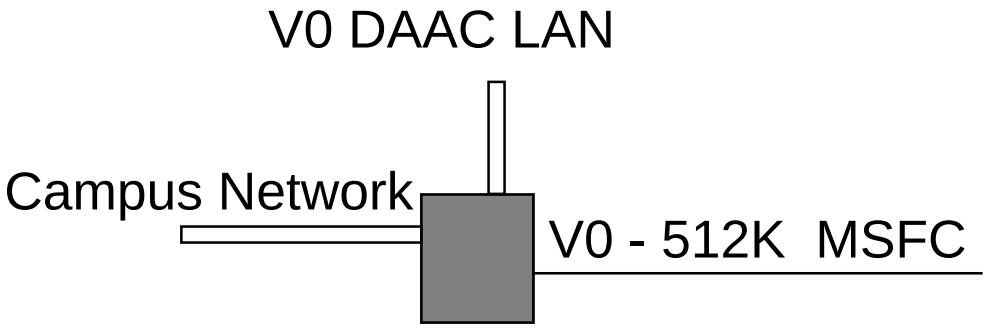
Nascom
Serial Lines:
GSFC - 832 Kbps

V0 router

EBnet router

EBnet

EDC Release A Design



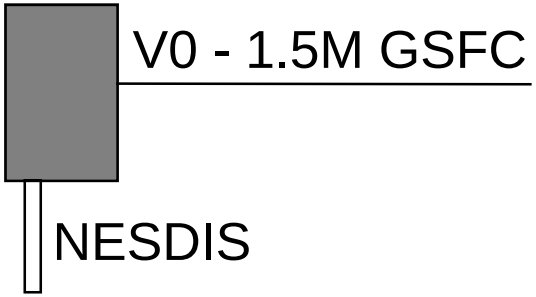
V0 Interfaces:
Ethernet: V0 DAAC LAN
Ethernet: Campus Network

PSCN
Serial Lines:
MSFC - 512K

V0 router

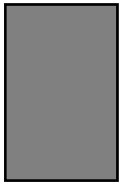
EBnet

NOAA Release A Design

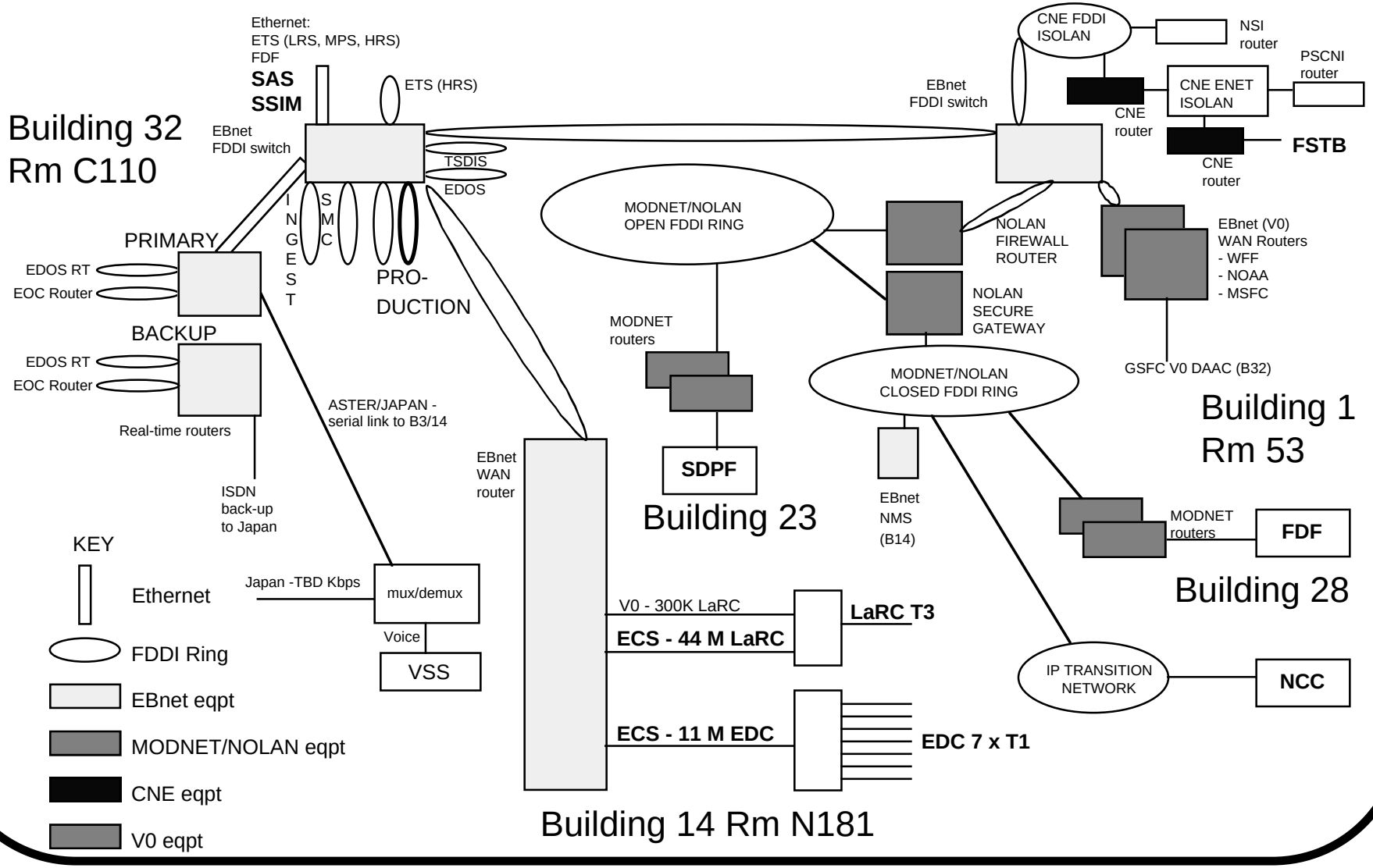


V0 Interfaces:
Ethernet - NESDIS

PSCN
Serial Line:
GSFC - T1

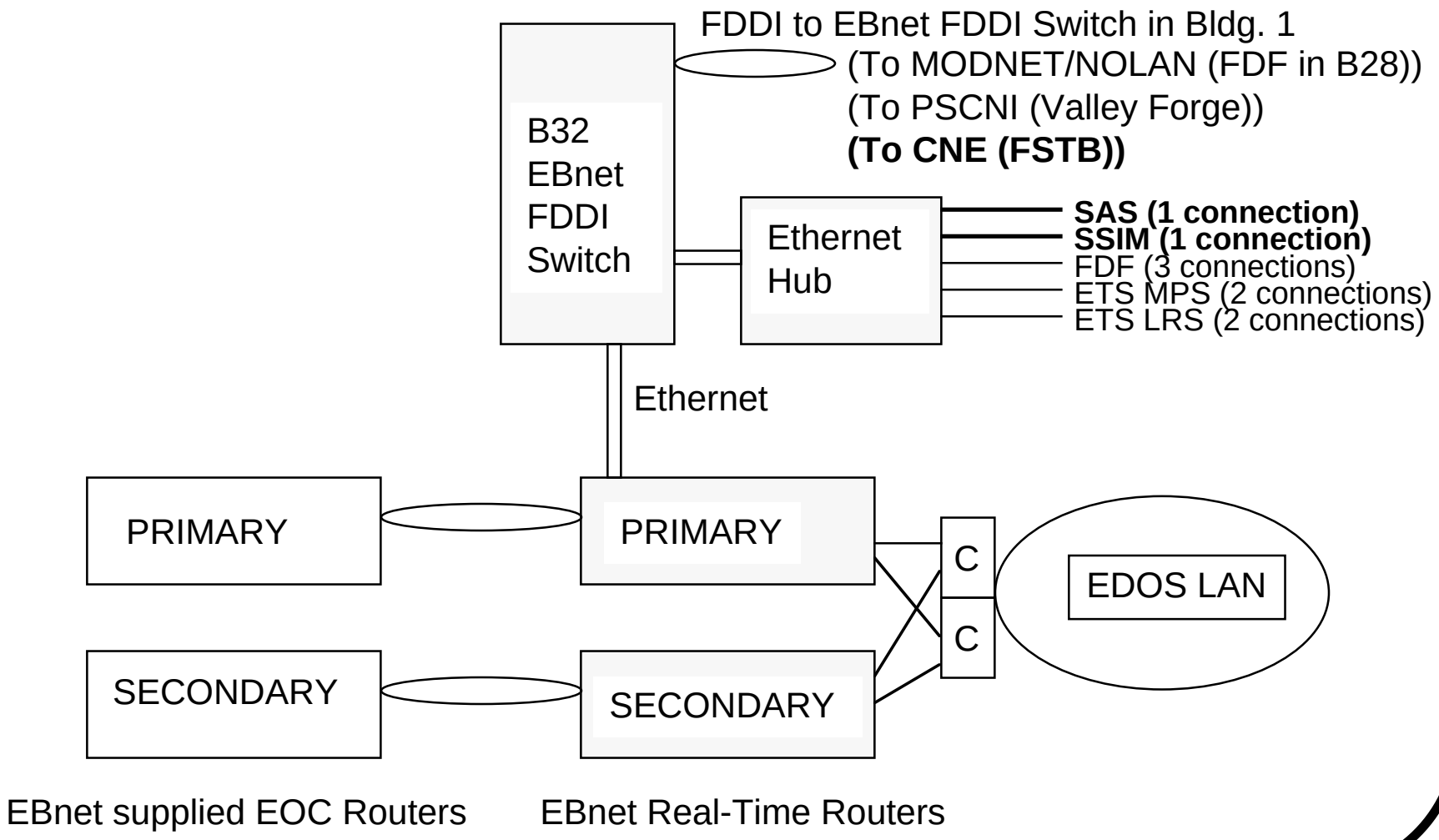


EBnet GSFC Site Design for AM1 Support (Release B)



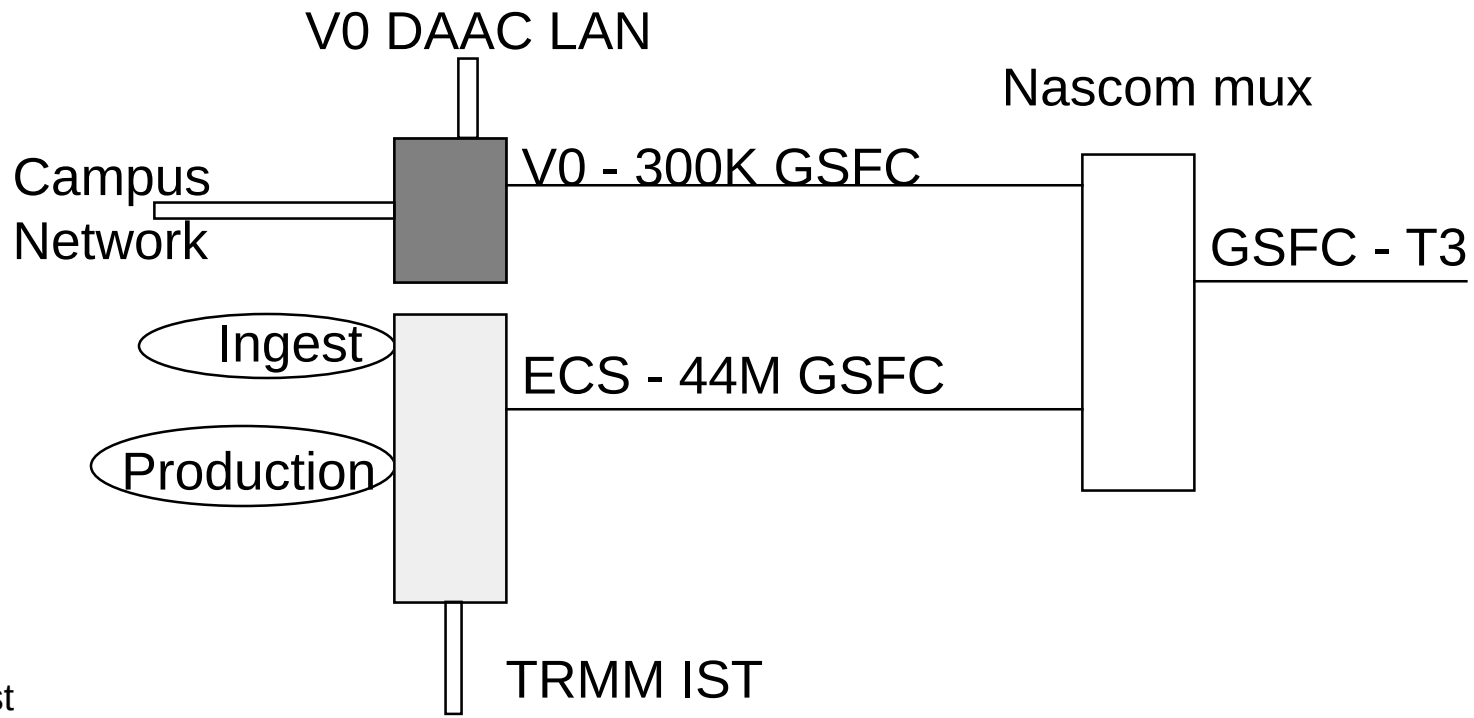
EBnet

EOC Interface Design for Phase II



EBnet

LaRC Release B Design



EBnet Interfaces:
FDDI - ECS Ingest
FDDI - ECS Production
Ethernet - TRMM IST

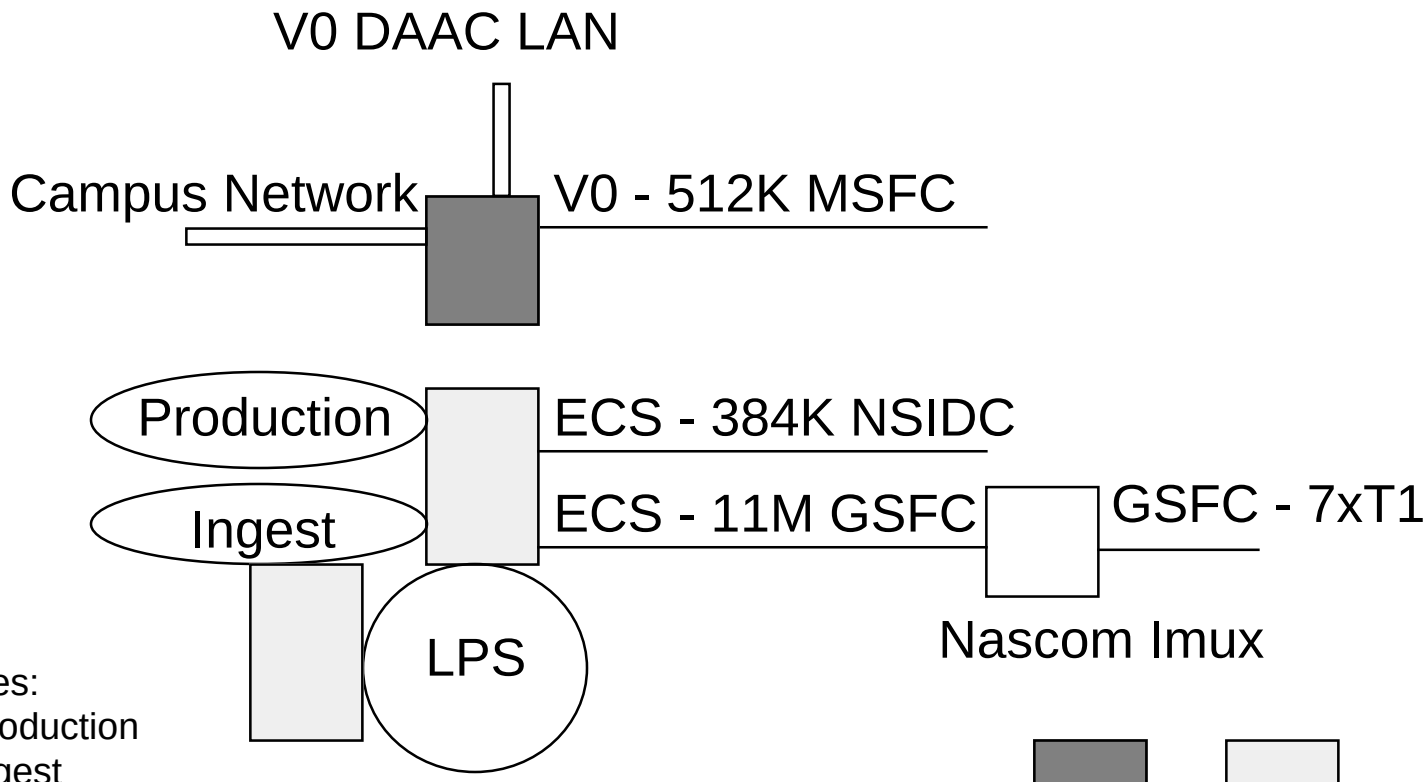
Nascom
Serial Lines:
GSFC - T3

V0 router

EBnet
router

EBnet

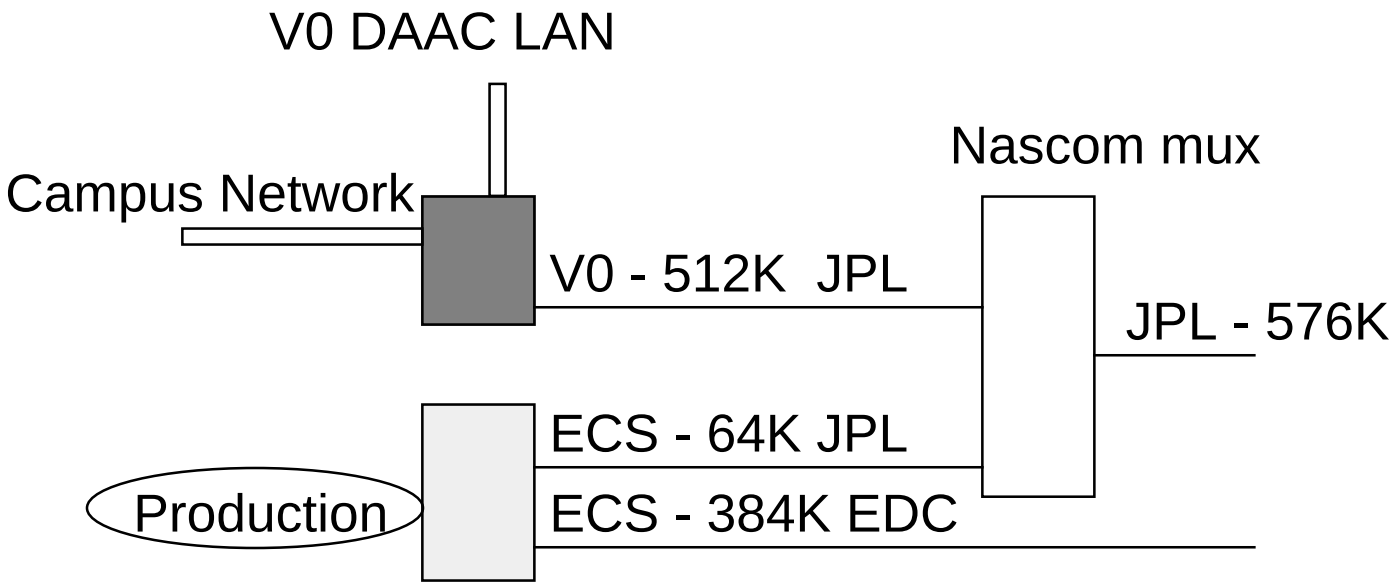
EDC Release B Design



EBnet Interfaces:
FDDI - ECS Production
FDDI - ECS Ingest
FDDI - LPS
Nascom
Serial Lines:
GSFC - 7xT1 (8xT1 in 1999)
NSIDC - 384K

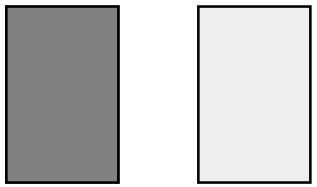
EBnet

NSIDC Release B Design



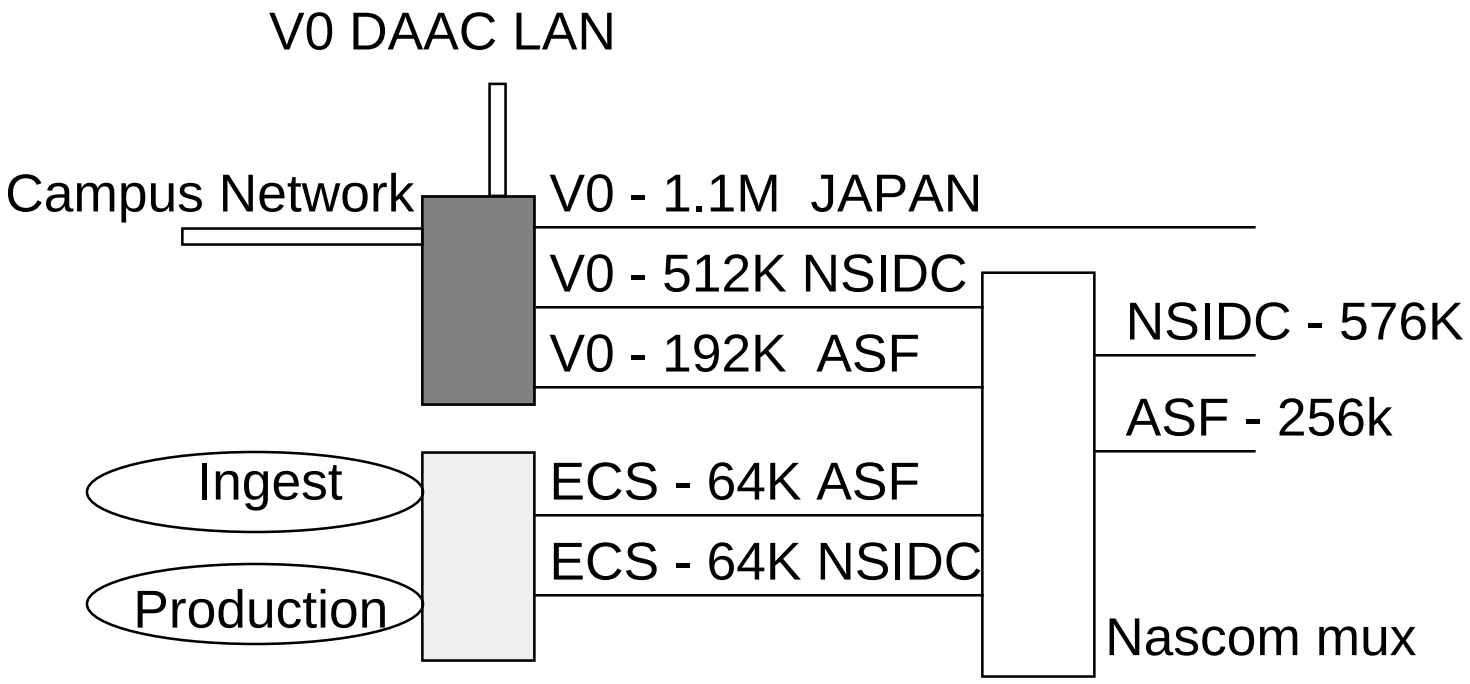
EBnet Interfaces:
FDDI - ECS Production

Nascom
Serial Lines:
EDC - 384K
JPL - 576K



EBnet

JPL Release B Design



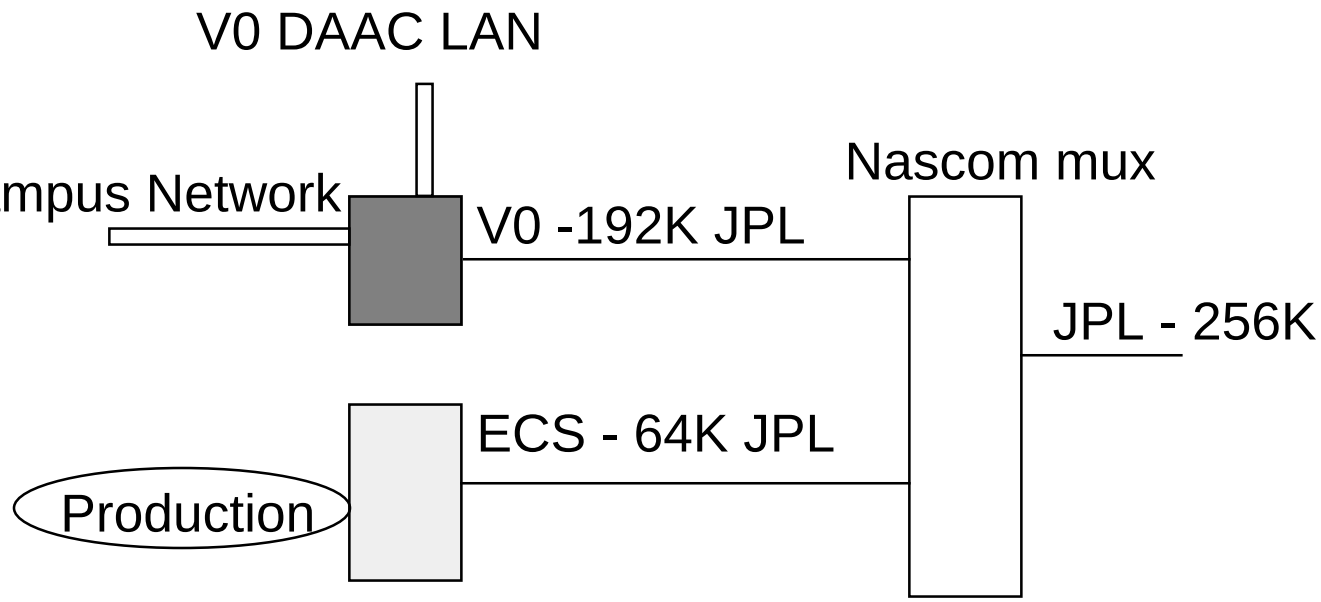
EBnet Interfaces:
FDDI - ECS Ingest
FDDI - ECS Production

Nascom
Serial Lines:
ASF - 256k
NSIDC - 576K

PSCN
Serial Lines:
JAPAN - 1.1M

EBnet

ASF Release B Design



EBnet Interfaces:
FDDI - ECS Production

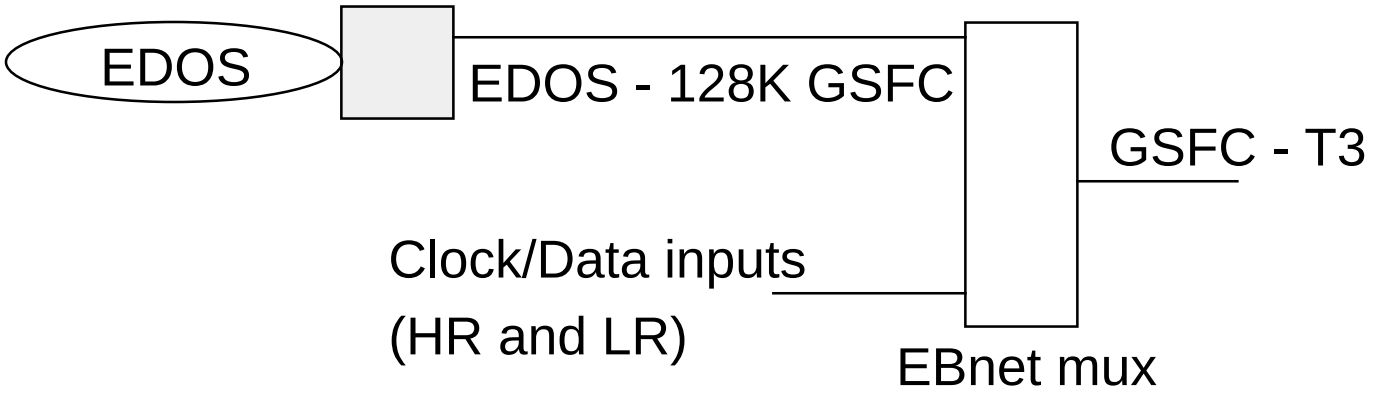
Nascom
Serial Lines:
JPL - 256K

V0 router

EBnet router

EBnet

WSC Design for IP data - 1/97



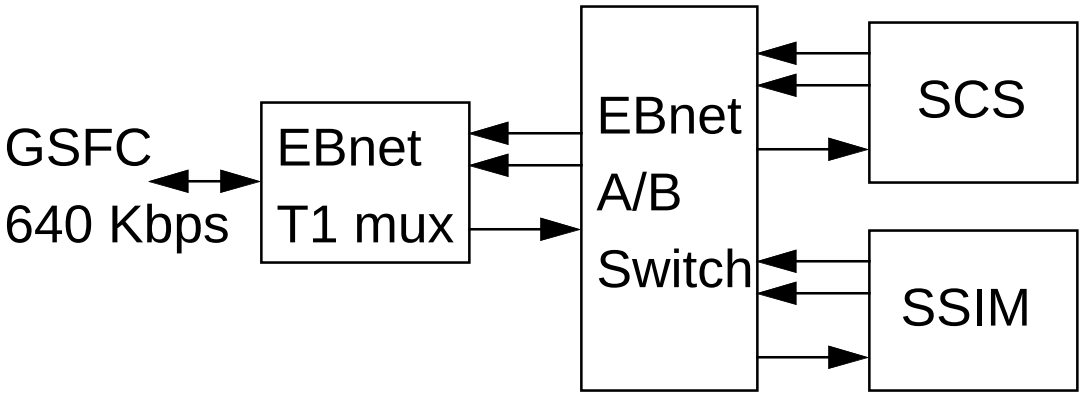
EBnet Interfaces:
FDDI - EDOS GSIF

Nascom
Serial Lines:
GSFC - T3

EBnet
router

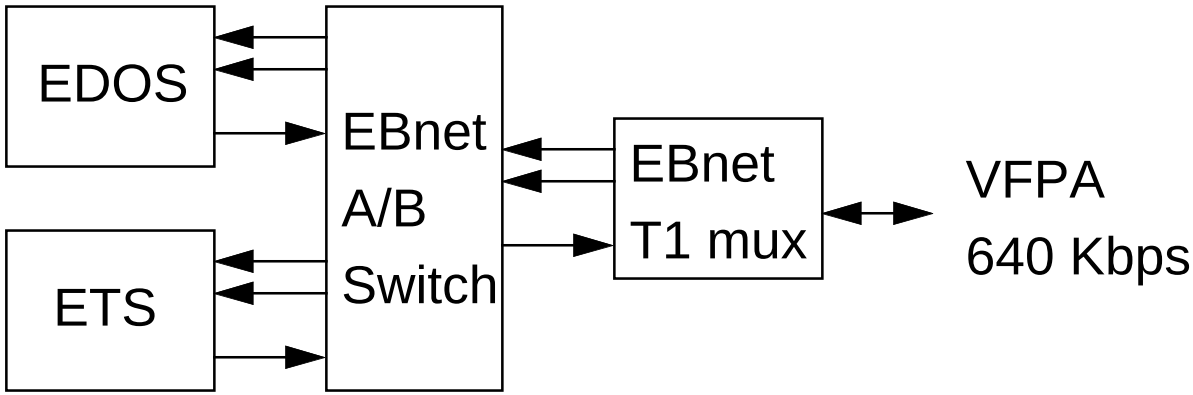
EBnet

VFPA detailed design for clock/data Return and forward link flows



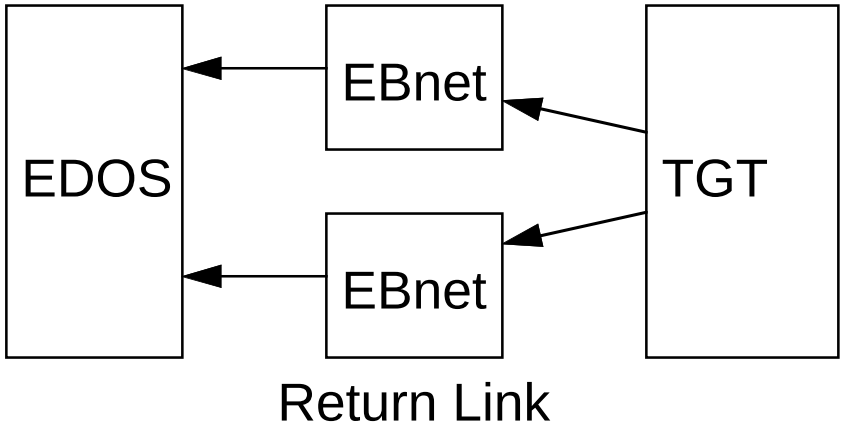
EBnet

GSFC detailed design for clock/data Return and forward link flows from VFPA

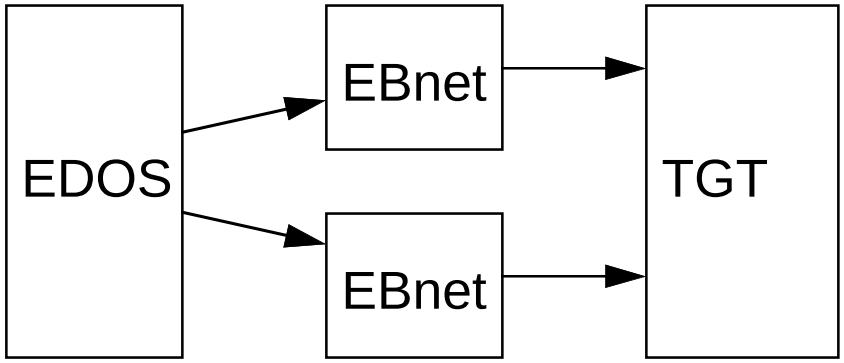


EBnet

ligh level architecture for adaptive downlink clock/data
Real time flows



Return Link



Forward Link

EBnet

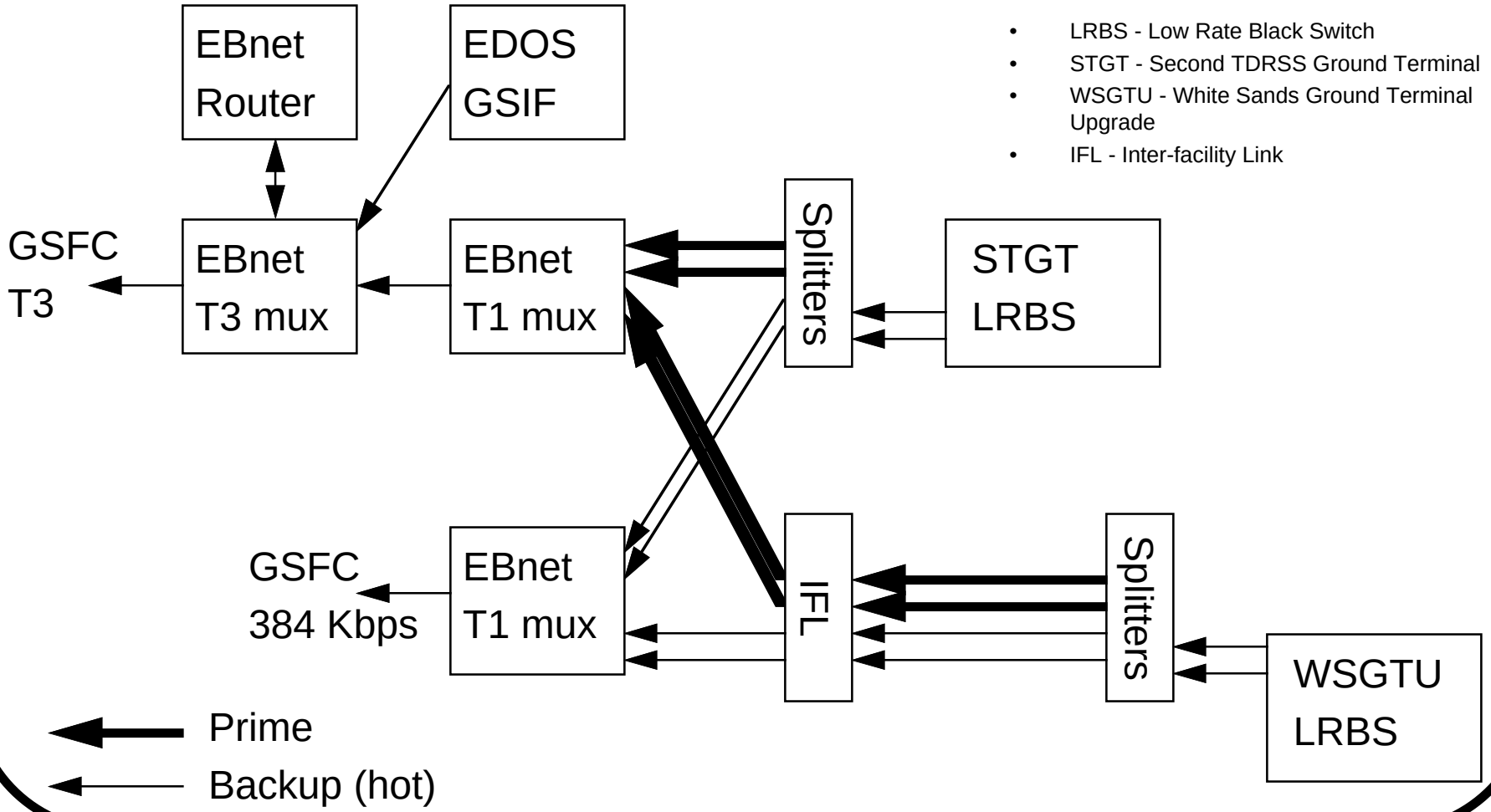
igh level architecture for adaptive downlink clock/data Real time flows

- Clock and data source produces redundant streams of data via splitters
- EBnet transmits both streams hot
- EBnet uses diversely routed carrier circuits to ensure reliability (no single point of failure in EBnet)
- Clock and data sink selects one of the two streams and has failover capability of some kind
- Does not apply to high rate flows
- Design presented supports AM-1 (one spacecraft)

EBnet

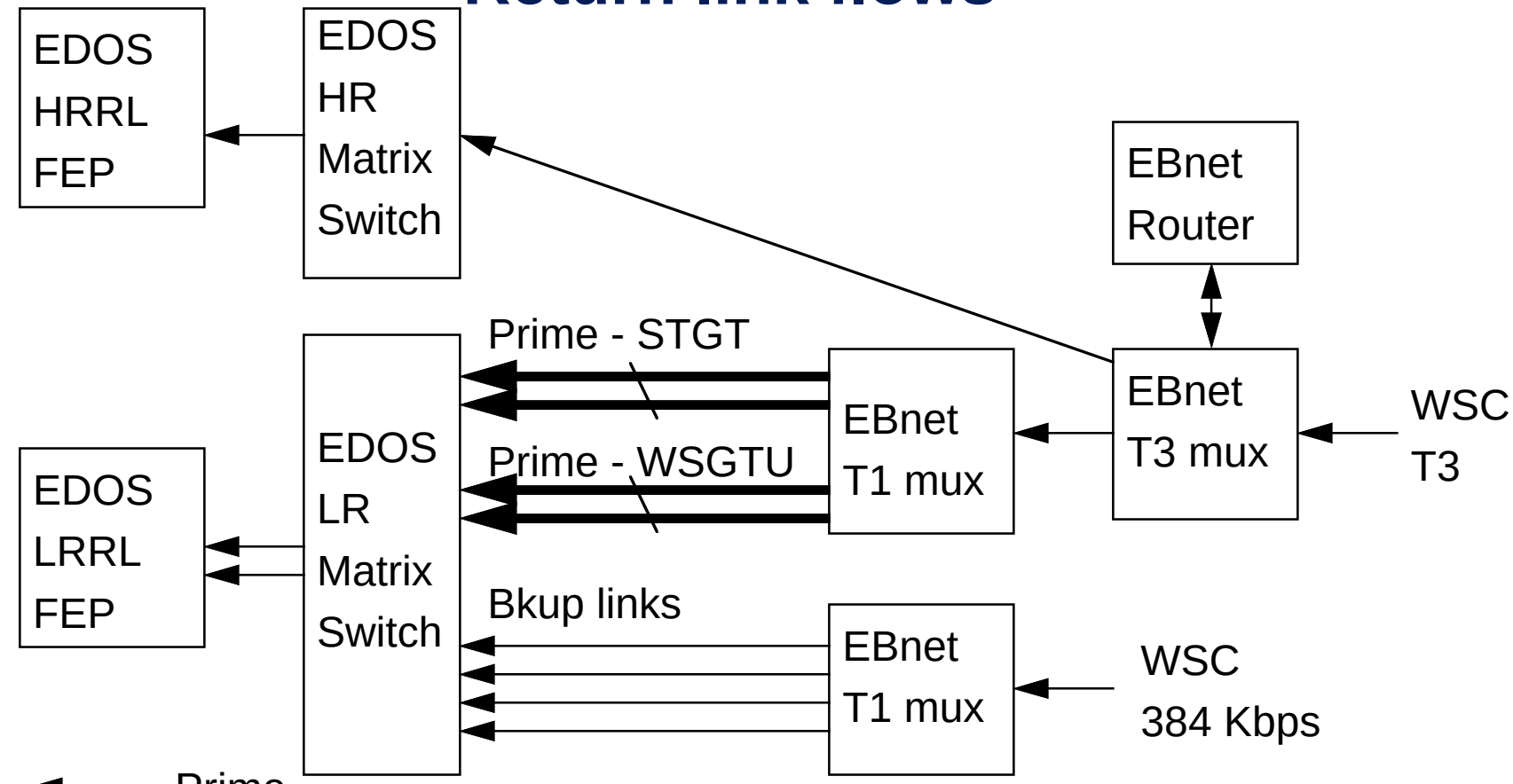
WSC detailed design for clock/data Return link flows

- LRBS - Low Rate Black Switch
- STGT - Second TDRSS Ground Terminal
- WSGTU - White Sands Ground Terminal Upgrade
- IFL - Inter-facility Link



EBnet

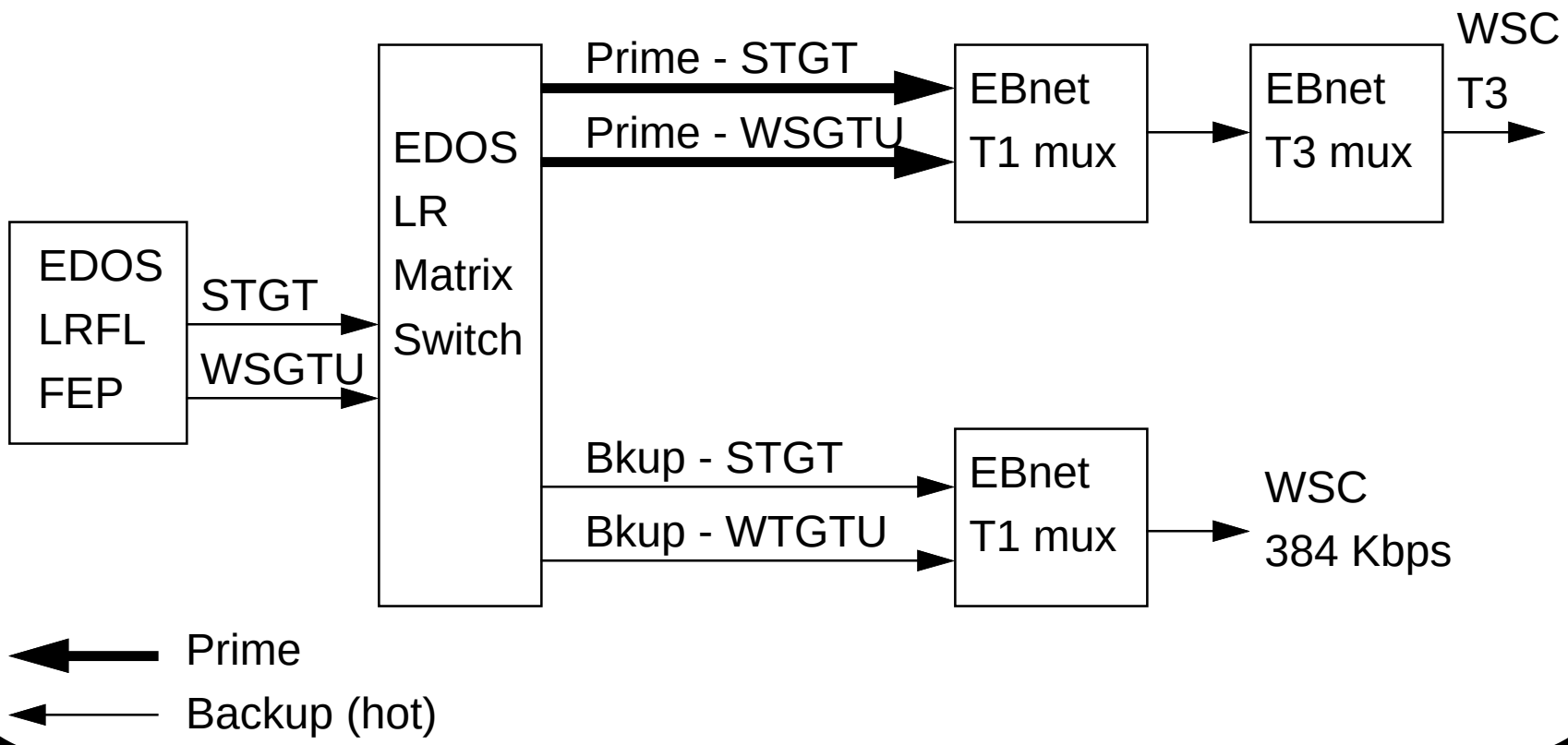
GSFC detailed design for clock/data Return link flows



- FEP - Front End Processor
- HRRL - High Rate Return Link
- LRRL - Low Rate Return Link

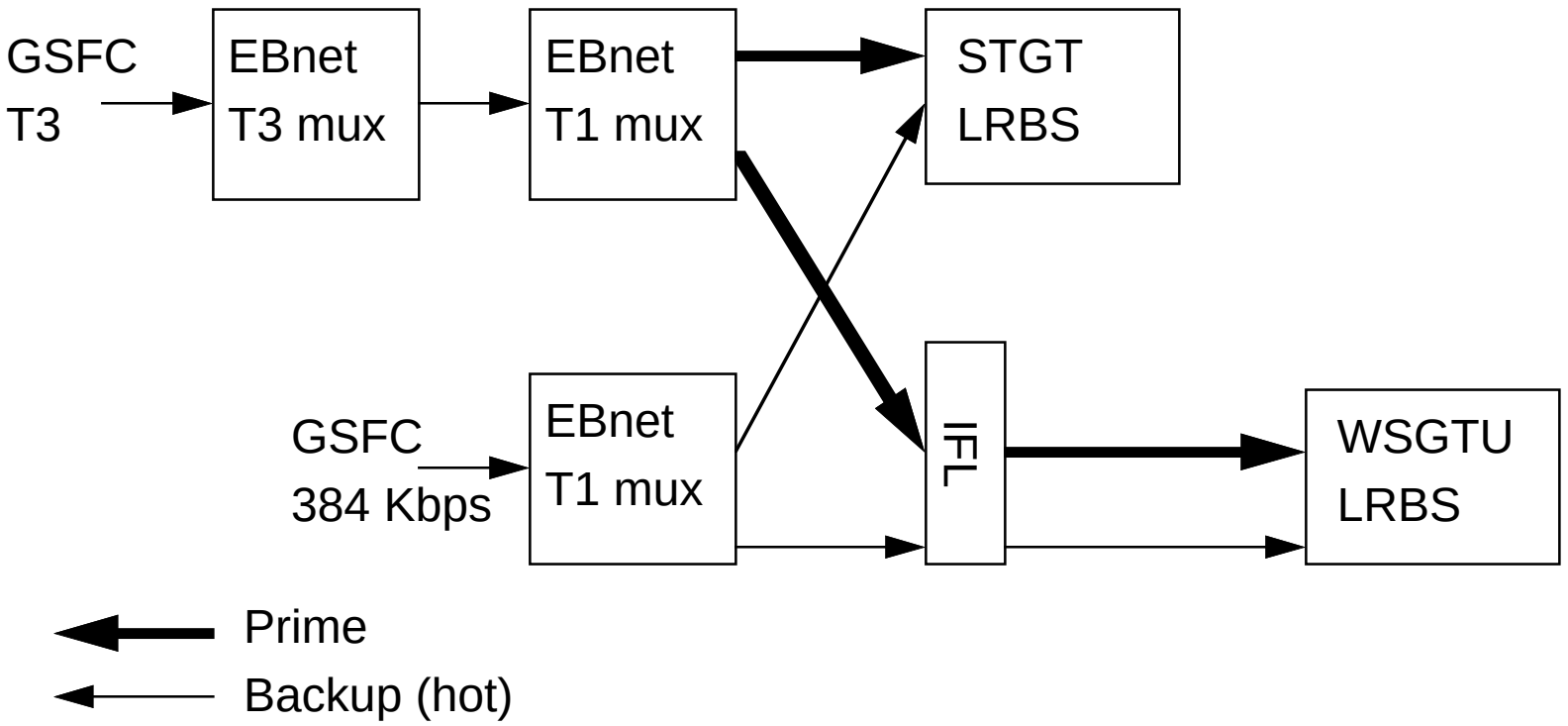
EBnet

GSFC detailed design for clock/data Forward link flows



EBnet

WSC detailed design for clock/data Forward link flows



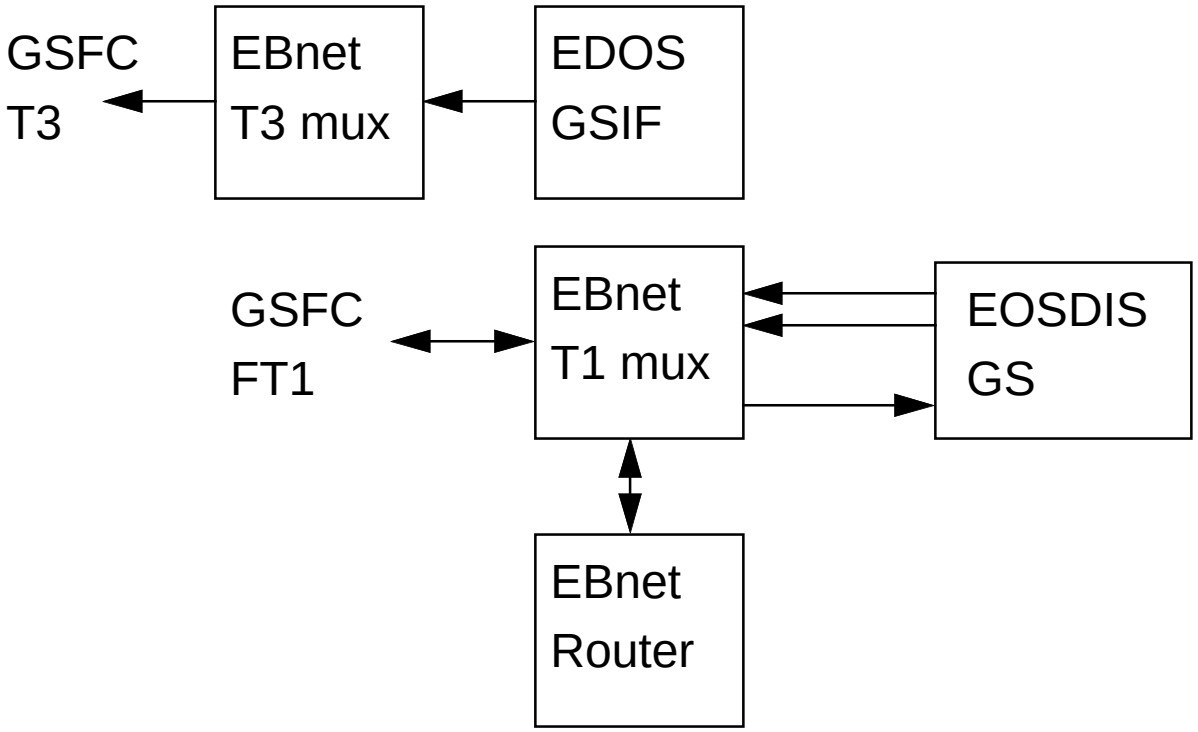
EBnet

High Latitiude Ground Stations

- EDOS GSIF at each EOSDIS Ground Station (EGS)
- Single EDOS LZPF at GSFC
- Low rate clock/data service from EGS to EDOS LZPF
- High rate clock/data service from EDOS GSIF to EDOS LZPF
- No diversity required for low rate services (impossible to achieve from Norway)
- Feasibility confirmed by tests run in December
  - GE Americom was able to run 45 Mbps from Spitzbergen to Holmdel NJ
  - Long term test planned to characterize seasonal behavior

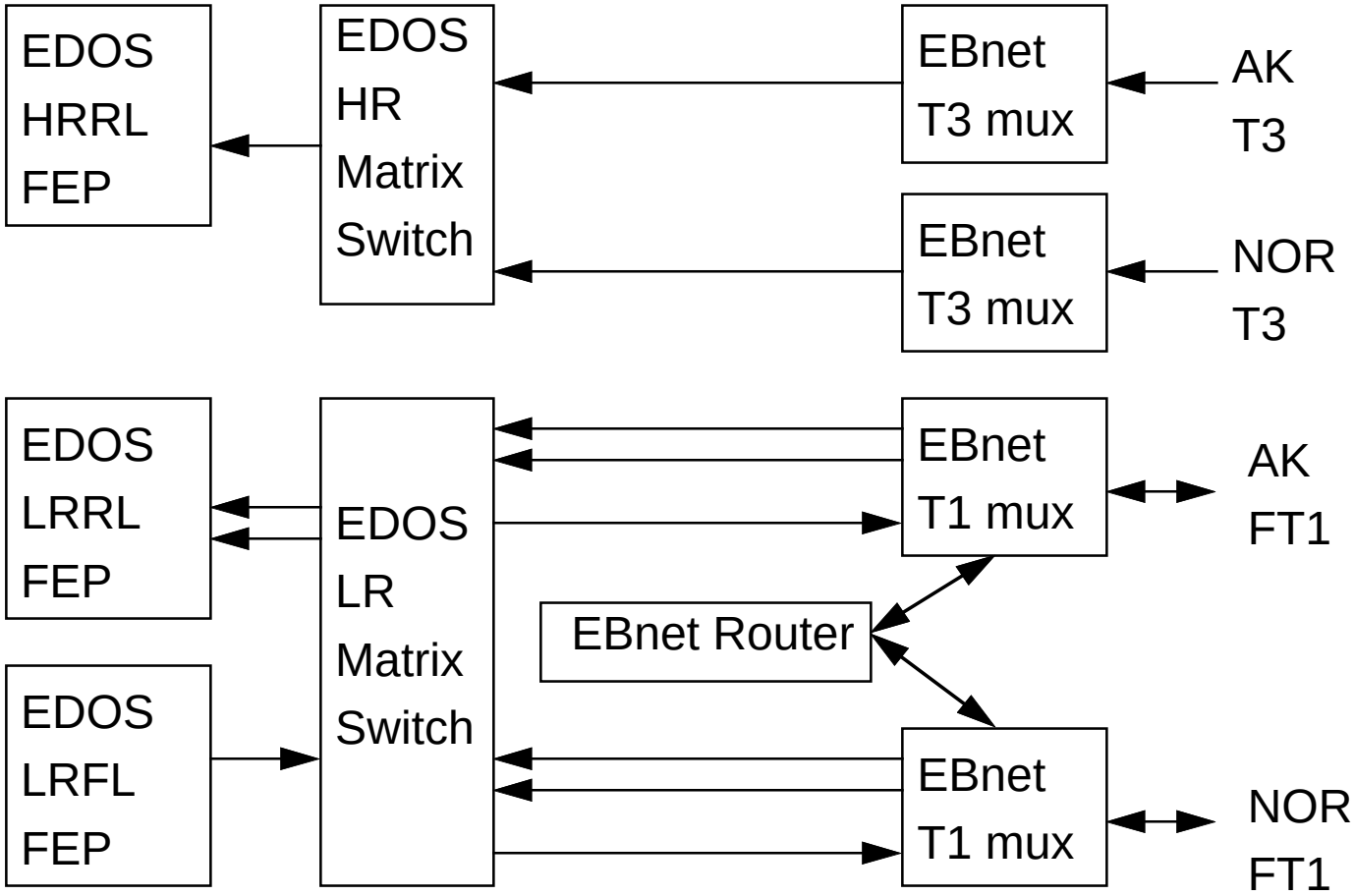
EBnet

Alaska/Norway detailed design for clock/data Return and forward link flows



EBnet

GSFC detailed design for clock/data Return and forward link flows from AK/NOR



EBnet

Implementation Approach

- EBnet implementation planned in phases
  - Transition of Version 0 Network (September 1995); completed
  - Integration of Version 0 Network and NOLAN to support Tropical Rainfall Measuring Mission (TRMM) testing (December 1995); completed
  - Network build-out to full EBnet capability; in progress
    - TRMM operational support (August 1996)
    - Landsat 7 testing and operational support (May 1997)
    - AM-1 testing and operational support (May 1997)

EBnet

Network Build-out to Full EBnet Capability

- EBnet Design Team has completed node designs
- Bill of Materials generated by node
- Hardware being procured by node, based on customer need date
  - Initial hardware procurements from SEWP contract
- Circuits being activated in a phased approach
  - Circuit capacities identified in topologies as a function of date
  - Domestic circuits procured from FTS2000 contract
  - International circuits competitively procured from commercial carriers

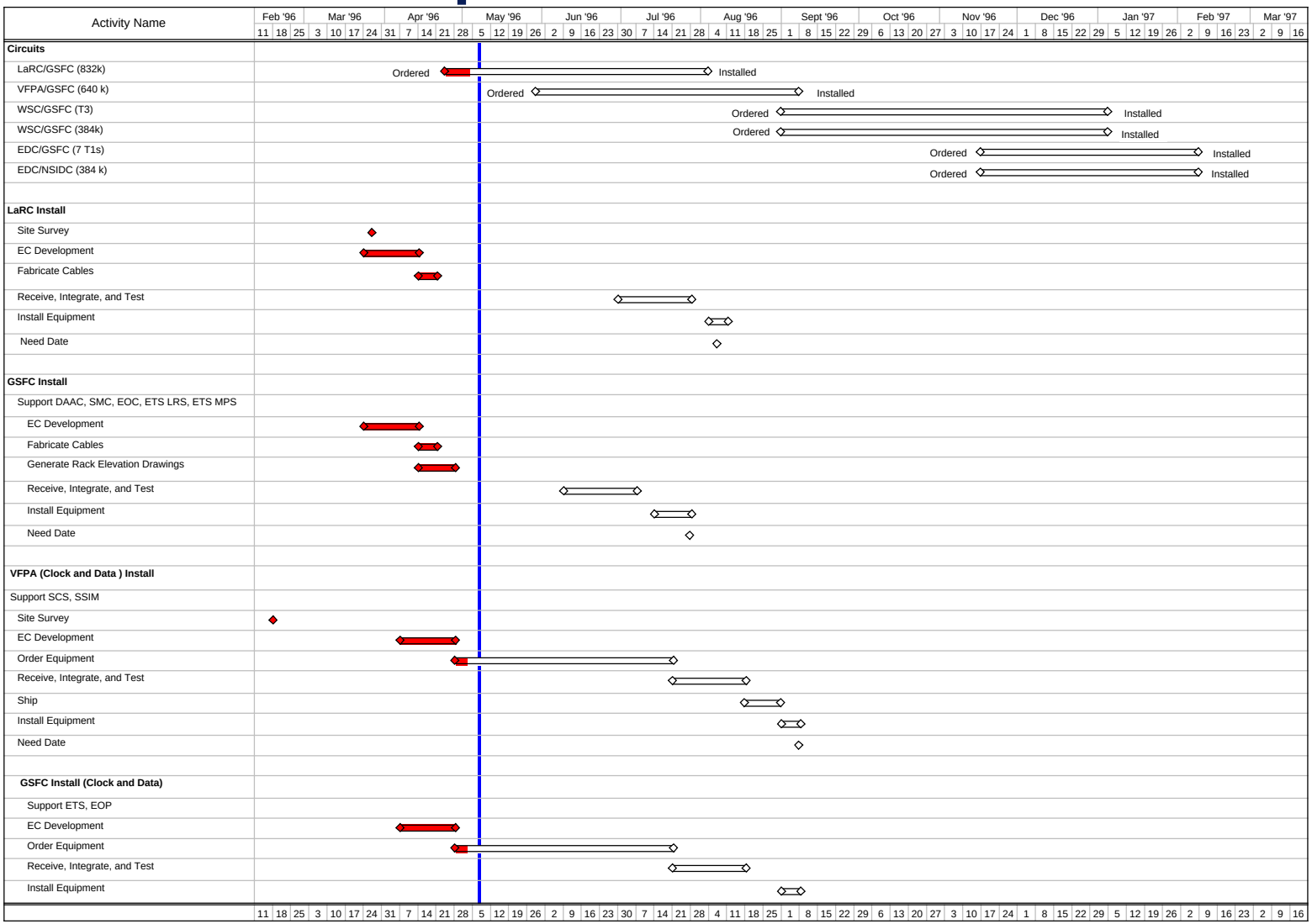
EBnet

Implementation Planning Sequence

- A sequence of steps will be followed during the implementation of each node
  - Site survey
  - Develop Engineering Change
  - Fabricate cables
  - Develop engineering drawings
  - Receive, integrate, and test equipment
  - Install equipment at sites
- All node installations are planned to be in place at customer specified need dates

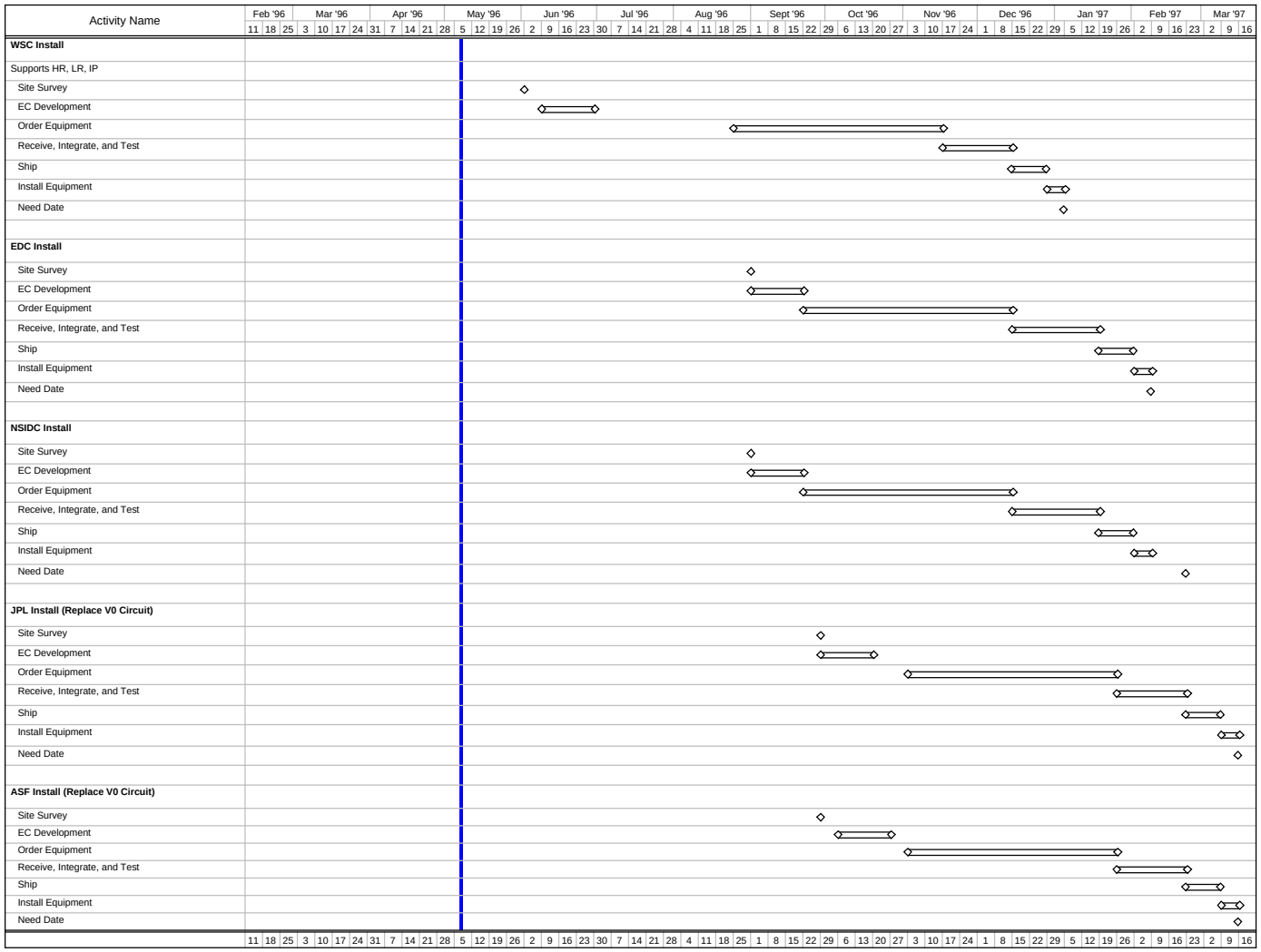
EBnet

EBnet Implementation Schedule



EBnet

EBnet Implementation Schedule (Cont)



EBnet

Testing

- EBnet Test Program
- EBnet Test Plan Overview
- EBnet Test Strategy
- EBnet Test Overview
- EBnet Requirements Verification
- External User Support

EBnet

EBnet Test Program

- Consists of both internal testing and support to external testing activities
- Internal testing program is comprised of:
  - Validating design functionality and performance
  - Verifying Level 2 EBnet Requirements, Volume 6
  - Performing acceptance testing
- External test support include:
  - EOSDIS Sister Project (e.g., ECS, EDOS) Testing
  - TRMM and Landsat-7 Project Testing
  - System Integration and Test (SI&T)

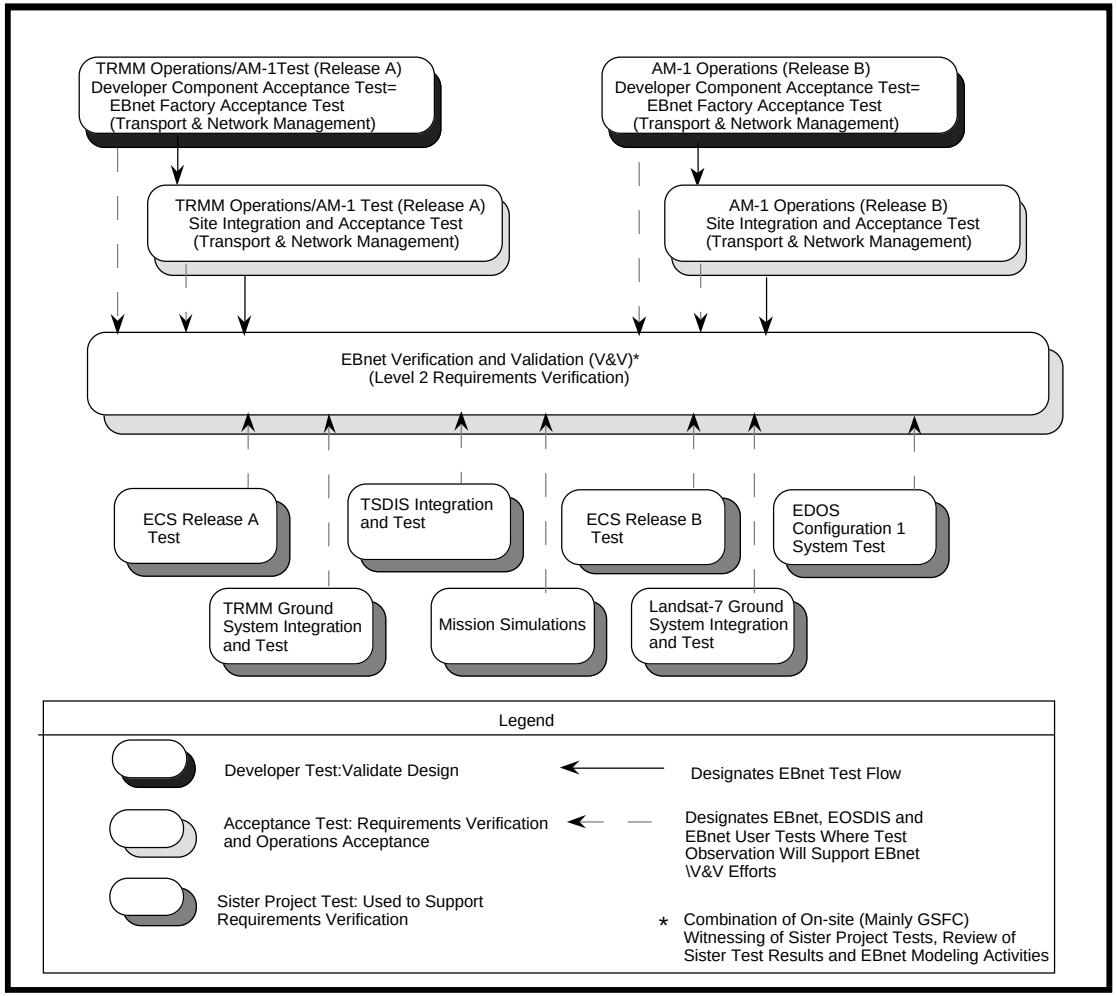
EBnet

EBnet Test Plan Overview

- EBnet Test Goals
  - Verify EBnet functionality before EOS Ground System (EGS) higher-level operational testing
  - Develop combined developer/acceptance test approach
  - Make best use of existing resources
  - Use existing EOSDIS sister projects and EBnet users tests to support requirements verification
  - Generate testing methodology that supports future EBnet network testing (including outsourcing of testing)
- EBnet System/Acceptance Test Plan and Procedures
  - Consolidated plan providing system and test overview, technical and management approaches, test procedures and requirements verification matrix
  - Two submissions of the plan will be performed: (1) System/Acceptance Plan at this review; (2) Test Procedures provided 30 days before FAT

EBnet

EBnet Test Strategy



EBnet

EBnet Test Overview

- Factory Acceptance Test (FAT) will provide the following:
  - EBnet design validation (transport and network management functions)
  - Government acceptance of the EBnet equipment
  - Test results to permit EBnet Project Manager to make shipping decision
- Site Integration and Acceptance Test (SI&AT) will provide the following:
  - Verify that each node is successfully integrated into the existing EBnet network
  - Operational acceptance of the EBnet equipment
  - Regression test transport functions using common-carrier circuits and available EBnet users, and network management functions
  - Use selected FAT procedures to support regression test
  - Test results to permit EBnet Project Manager to make a decision related to readiness to support EOSDIS and EBnet users operational testing

EBnet

Requirements Verification

- Requirements Verification will provide the following:
  - Verify requirements documented in the ESDIS Level 2 EBnet Requirements Document, Volume 6; traceability analysis performed using Requirements and Traceability and Management (RTM) software
  - Test results will provide EBnet Verification and Validation (V&V) the capability to generate requirements assessment for EBnet Project Manager review
- Requirements Verification will use the following evaluation methods:
  - Technical Analysis: modeling, simulation and document review
  - Inspection: evaluation of visual EBnet equipment characteristics
  - Test: observation of EOSDIS sister projects and EBnet users; no independent testing planned
- Requirements Verification will be conducted:
  - In two phases paralleling EBnet phased implementation approach
  - Use of modeling/simulation tool is the only test equipment planned

EBnet

External User Support

- EBnet support appears applicable to the following tests:
  - TRMM Early Test: ECS IR1, IV&V IR1 Component **(Completed),** SI&T Test Version and TRMM Project **(In-Process)**
  - Release A: TRMM and TSDIS Projects, EDOS Version 2, ECS Release A, SI&T Version 1
  - Release B: EDOS Version 3, Landsat-7, ECS Release B, SI&T Version 2, EDOS Configuration 1
- Envisioned EBnet support requirements include:
  - Test planning and support: Participate in ESDIS Test Integration & Certification Test Oversight Committee and Integrated Product Team activities. Review test plans, coordinate resources and support test execution
  - Common carrier circuits: Provide required EBnet circuits to support testing; various test organizations contacted; information being analyzed and any new requirements being placed in EBnet Traffic Database
  - Operations: Ensure EBnet network is available for testing efforts

EBnet

Overview

- Implementation approach
- Implementation plan
- Network management system overview
- Implementation status

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Implementation Approach

- Phased implementation
  - Design and integrate in small pieces
  - Minimize customization from the outset through the extensive use of COTS
- System release in multiple deliveries
  - Prioritize functions for each delivery
  - Leverage on market trends
- Continue network management product testing and evaluation capability within EMAT
- Keep the system simple; operators will use it, not engineers

EBnet

Implementation Plan

- Delivery I, Completed 2/1/96
  - Integrate Simple Network Management Protocol (SNMP) management system with a reporting engine
  - Use trouble ticketing system integrated with a relational database management system
  - Provide interface to SMC
- Delivery II, 9/1/96
  - Evaluate and implement physical management and remote monitoring (RMON) probes
  - Implement inter-domain exchange of fault management information
  - Select and implement out-of-band management system
  - Evaluate (and implement where desirable) additional 3rd party applications (Netsys, NerveCenter)

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Implementation Plan (cont)

- Delivery III, 12/1/96
  - Continued refinements of the system based on operational experience
  - Evaluate additional 3rd party products (Firstwatch, Concord Trakker, Ciscoworks)
  - Additional data collection and report generation as required

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NMS Overview
Delivery 1

- Customized HPOpenView Network Node Manager
  - Primary and hot backup with automatic data sharing and operator controlled failover
  - Collecting data on utilization, for error monitoring and for trend analysis
  - Frequency of data collection based on linespeed
  - Real-time data reporting available for troubleshooting
- Customized Remedy Action Request System (Trouble ticketing)
  - Automated workflow rules
  - Reports available on classes of nodes
  - Trouble tickets available via WWW
  - Sybase System 10 backend (Relational database management system with SQL)

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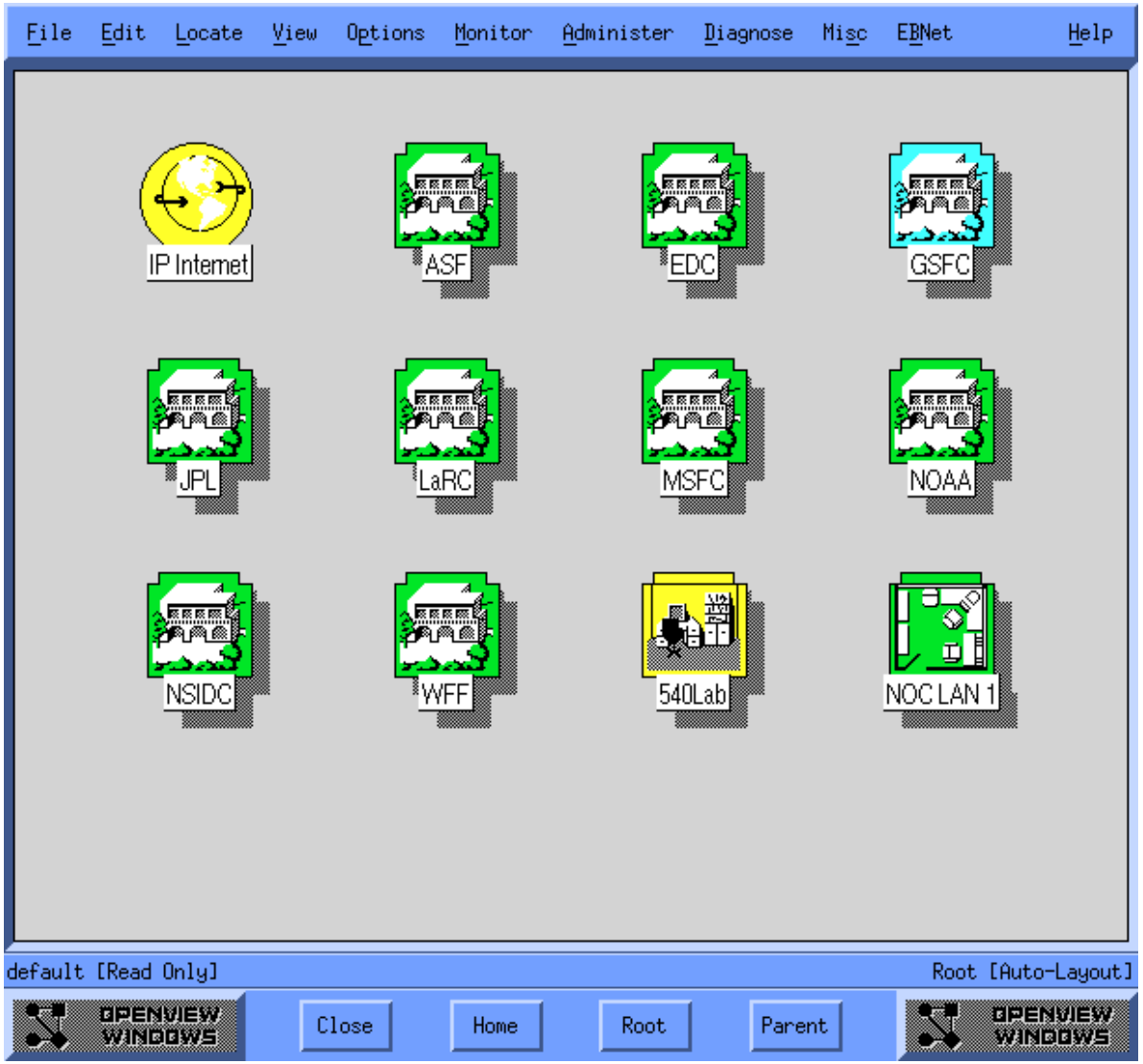
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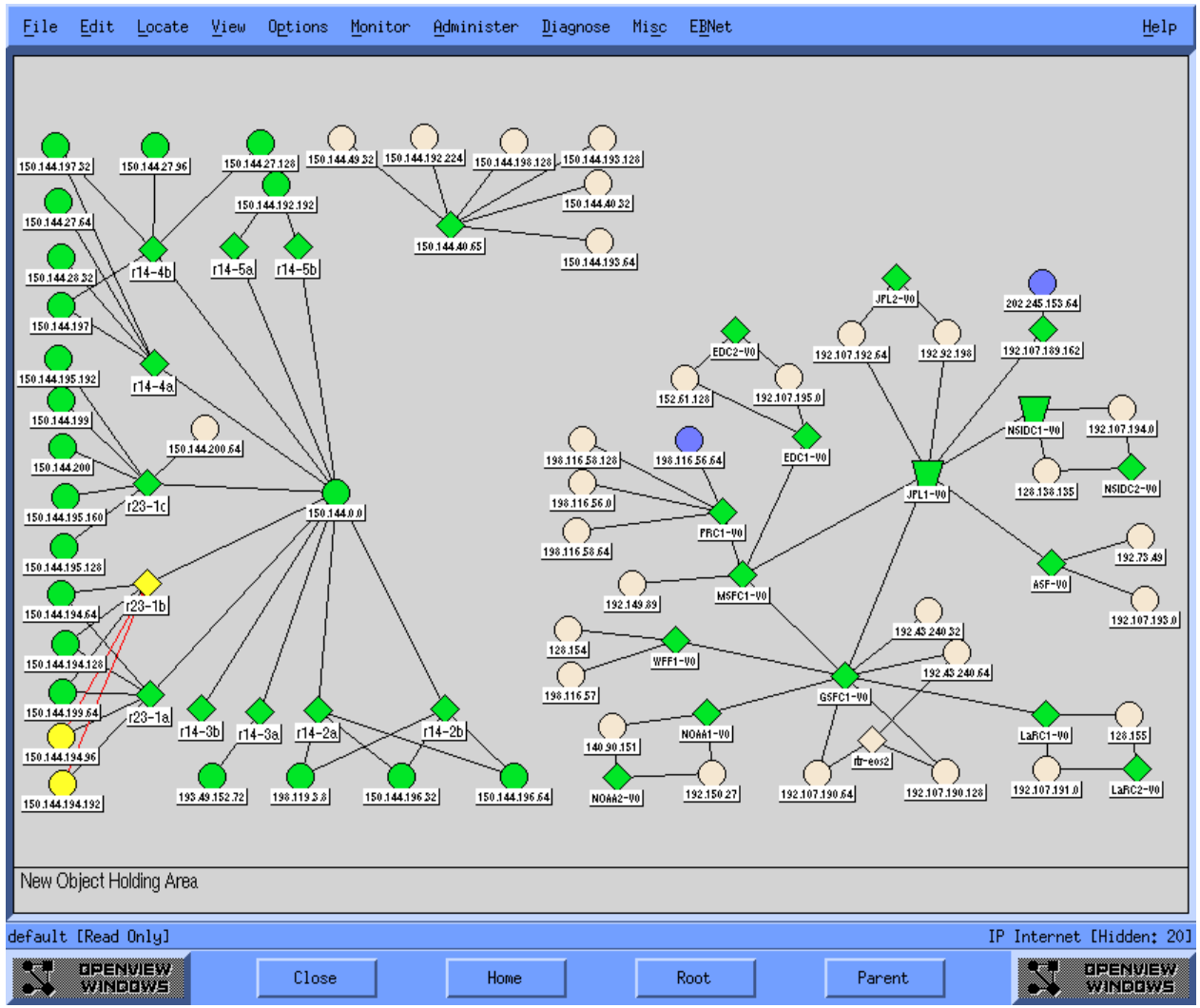
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NOAA1-V0
LaRC1-V0
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NOAA2-V0
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OPENVIEW WINDOWS
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OPENVIEW WINDOWS

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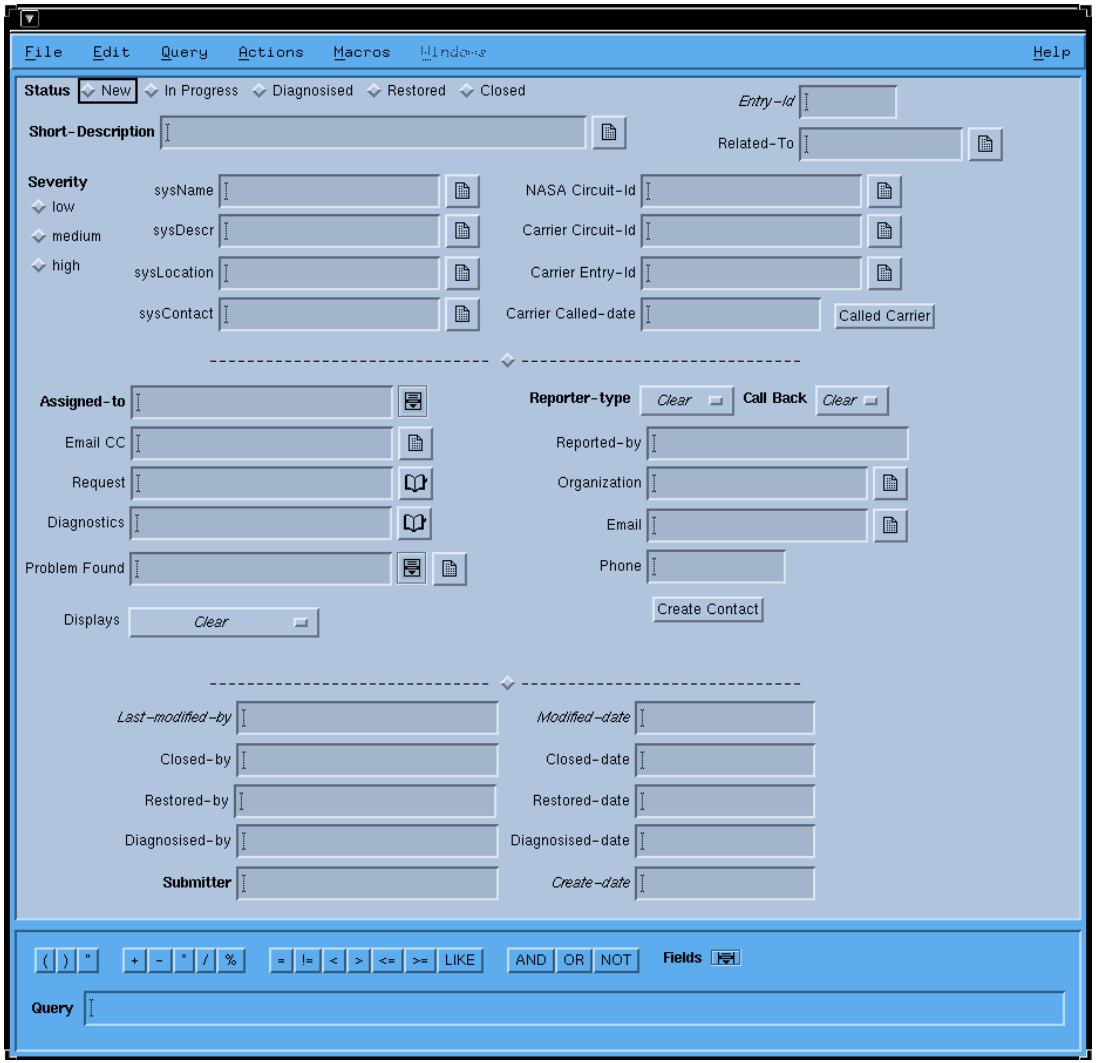
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NMS Overview (cont)

- Statistical Analysis System (SAS) for report generation and performance analysis
  - HPOpenView data archived from primary to secondary and to SAS performance database every eight hours and reduced
  - Data is further reduced weekly, monthly and yearly
- System is connected on the closed side of Nascom Operational LAN (NOLAN) behind the secure firewall
  - SMTP, SNMP, SNMP trap and ICMP passed through the firewall
  - System uses tcpwrappers for additional security
- Worked with DSNO Enterprise Management Concept team to develop an interdomain trouble ticket schema for EOSDIS interdomain exchange of fault information

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NMS Configuration

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Implementation Status of Delivery II

- All Delivery II equipment and software has been ordered
- Temporary development systems are installed in EMAT lab (including HPOpenView, SAS, Sybase, and Remedy) and Delivery 1 environment duplicated
- Working on implementation of Remedy transfer schema and implementation of interdomain trouble ticket exchange and notification
- Evaluating third-party add-on products that will provide enhanced monitoring and management capabilities
  - Netsys router management software
  - RMON software
  - Sybase WWW tools
  - NerveCenter event correlation software
- Evaluated and tested out-of-band management options, including integration with HPOpenView

EBnet Implementation Status (cont)

- All NOC furniture has been installed
- Defining new reports and plots (including utilization vs. errors over time and utilization vs. packet drops over time)
- Making continued refinements based on usage

EBnet High Level Operations Concepts

- Staffing
- Roles and Responsibilities
- Escalation Process
- Internal Workflow
- EOSDIS Interdomain Information Exchange

EBnet

Staffing

- Comm Manager (24x7 on site)
- In the Network Operations Center (NOC)
  - 2 Operators staff Helpdesk (24x7 on site)
    - Lead
    - Backup
  - Network manager (8x5 on site, 24 hour on-call)
- At GSFC
  - Maintenance technicians (24x7 on site)
- At other sites:
  - Agreements with DAAC staff and local site personnel (8x5 on site, 24 hour on-call)
  - Vendor support (4 hour service restoral)
- In the EMAT lab:
  - Design engineers (8x5 on site)

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Roles and Responsibilities

- Comm Manager
  - Coordination of information and events across all Nascom elements including EBnet
- Lead and back-up operators
  - Working knowledge of all applications and operating systems
  - Interface with customers and users via the helpdesk to isolate, diagnose and resolve problems
- Network manager
  - All functions performed by operators
  - Second tier troubleshooting and problem resolution
  - Understand system-wide issues
  - Resolve all open problems

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Escalation Process

- First tier: Operators
- Second tier: Network manager
- Third tier: Design engineers
- Fourth tier: Vendor maintenance and technical troubleshooting agreements

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From User Organizations, HPOV/Operator observation, Comm Manager

Problem Alert!!!

Open Trouble Ticket!

EBnet NOC Operator

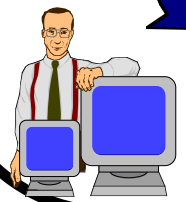
Operator troubleshoots to isolate/resolve problem

Involves engineers, carriers, remote site personnel and vendors as necessary

Operator closes trouble ticket when problem is resolved

Comm Manager keeps users informed!

Keep Comm Manager Informed!



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Internal Workflow

- The Comm Manager is the focal point for information exchange and coordination across all Nascom systems. The Comm Manager coordinates with the EBnet NOC Helpdesk and they keep each other informed of status
- Users will report problems directly to the EBnet NOC or to the Comm Manager
- EBnet operators will have a much higher skill level than operators on legacy systems
- Operators troubleshoot problems and route trouble tickets through the system as necessary to technicians, carrier or Network Manager
- Operators are informed at all times of problem/solution status
- Remedy automatically escalates problems not resolved within predefined time constraints

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EOSDIS Inter-domain Information Exchange

- All EBnet trouble tickets and status updates will be made available via the WWW
- EBnet trouble tickets will be distributed electronically to the SMC, EDOS, the LSMs and the EOC
  - Interdomain exchange will use Remedy's email-based trouble ticket exchange mechanism utilizing the EMC's common Remedy transfer schema whenever possible
- EBnet will accept electronic trouble tickets via email and transfer schema

EBnet

Background

- General Services Administration (GSA) FTS2000 Contract
  - Nascom performance requirements resulted in a contract modification, Network Service Assurance Plan (NSAP)
  - Includes T1 multiplexer and Digital Access Cross Connect (DACC) switch to provide required performance at DS0 level
  - Always intended to utilize FTS2000 for EBnet circuits
- NASA Networks Consolidation Decision
  - Lead given to MSFC to consolidate NASA Network (9/95)
  - Consolidation and outsourcing dictated by:
    - shrinking budget
    - provisioning of services to many of the same locations
    - “routine operations”
    - convergence of performance requirements
    - use of commercial services

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Current Activities

- Nascom/EBnet has been working additional modifications to FTS2000 Network A contract with GSA and AT&T, tentatively called NSAP-II
  - Builds off existing NSAP contract modifications
  - Predicated on IP services
  - Includes customer premise equipment
    - IP routers
    - T3 multiplexers
    - Inverse multiplexers
    - Asynchronous Transfer Mode (ATM) switches
  - Includes T1, T3, and OC-3 circuits
  - Supports ATM service
  - Includes Network Management System
  - Supports use of GFE for all existing equipment identified under modification
  - Specify different performance parameters by service
  - Provides for engineering, maintenance, and operations

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Current Activities (Cont'd)

- NSAP-II is the vehicle for outsourcing NASA Networks
  - Modifications and details still being worked
  - Contract modification scheduled for 10/1/96
- NASA network consolidation being worked with Marshall Space Flight Center (MSFC) and Ames Research Center (ARC)
- Outsourcing of Nascom wide area IP networks to be completed by March 1997
- Nascom will maintain current operations center in Building 14
  - Comm Mgr still Point of Contact
  - Slaved Network Management System configuration continues to reside in Nascom
  - Will coordinate across all WAN and LAN Nascom activities

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Summary

- EBnet will continue implementation via SEWP until NSAP-II is in place
- Future EBnet services will be obtained via NSAP-II
- EBnet customer interface will still reside in Nascom

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Schedule Considerations

- EBnet project Project Evaluation Review Technique (PERT) chart identifies customer-driven milestones; primary schedule drivers include test support for Release A required by July 1996, and AM-1 and Landsat 7 test support required by January 1997
- EBnet critical path is dependent on external milestone
  - 40 days slack between EBnet AM-1 Review and AM-1 Test Readiness
- Master Schedule shows high level milestones, dependencies, and activities for specific segments during the Project life-cycle
- Detailed Milestone schedule identifies specific activities associated with EBnet implementation

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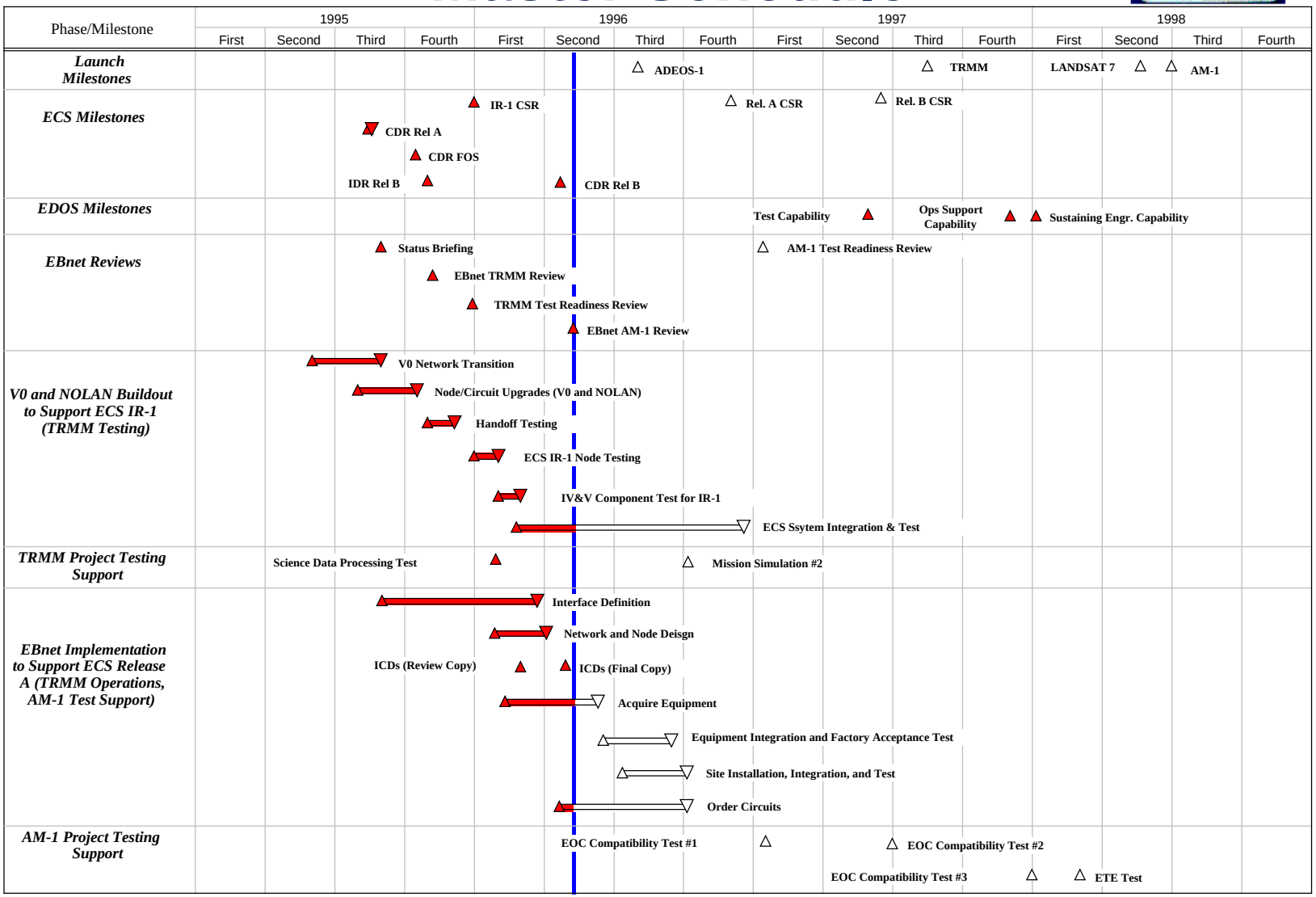
Master Schedule



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Success Criteria Summary

- EBnet detailed design developed to support AM-1; includes optimized circuit topologies, network transport and network management capabilities
- Documentation suite has been defined for the full life-cycle
- External and internal interfaces for AM-1 have been documented
- The EBnet Project is on schedule to support TRMM, Landsat-7, and AM-1
- Traceability analyses performed using Requirement and Traceability Management (RTM) software
- Operations concept and plan to train resources are place
- All significant implementation events, critical path, and external dependencies have been considered, and risk mitigation plans are in place as appropriate

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Issues and Concerns

- None

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RID Process Recap

- Use the RID form as supplied in hard-copy or on the EBnet Home Page at:

  http://skynet.gsfc.nasa.gov/EBNET/EBnet.html
- Transmit RIDs via e-mail to:
- BERGANSKIK@BAH.COM no later than 05/16/96

Please use the “COMMENT/CLARIFICATION FORMS,” located in the back of the auditorium, if you would like to submit a comment or have one of our presenters contact you to elaborate on a point made during the presentation.

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ACRONYMS

AHWGP	Ad Hoc Working Group on Production
ARC	Ames Research Center
ASF	Alaska SAR Facility
ASTER	Advanced Spaceborne Thermal Emission Radiometer
ATM	Asynchronous Transfer Mode
ATSC	AlliedSignal Technical Services Corporation
BA&H	Booz•Allen & Hamilton Incorporated
BGP	Border Gateway Protocol
c/d	clock/data
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CNE	Center Network Environment
COTS	Commercial off-the-shelf
CSC	Computer Sciences Corporation
DAAC	Distributed Active Archive Center
DACC	Digital Access Cross Connect
DID	Data Item Description
DIF	Data Interface Facility
DMR	Detailed Mission Requirements
DSN	Deep Space Network
DSNO	Distributed Systems Networks Organization
EBnet	EOSDIS Backbone Network
ECS	ESDIS Core System
EDC	EROS Data Center
EDOS	EOS Data and Operations System
EGS	EOSDIS Ground Station
EMAT	EBnet Modeling and Analysis Testbed
EMC	Enterprise Management Concept
EOC	EOS Operations Center
EOP	EDOS Operational Prototype
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ESN	EOS Science Network
ETE	End-to-End
ETS	EOSDIS Test System
FAT	Factory Acceptance Test
FDDI	Fiber Distributed Data Interface
FEP	Front End Processor
FDF	Flight Dynamics Facility

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ACRONYMS

FOS	Flight Operations Segment
FSTB	Flight Software Testbed
FTS	Federal Telecommunications System
GDS	Ground Data System
GFE	Government Furnished Equipment
GHCC	Global Hydrology Change Center
GN	Ground Network
GSA	Government Services Administration
GSE	Ground System Equipment
GSFC	Goddard Space Flight Center
GSIF	Ground Station Interface Facility
HDS/ETU	Hybrid Dynamic Simulator/Engineering Test Unit
HITS	Hughes Information Technology Systems
HP	Hewlett Packard
HP OV	Hewlett Packard OpenView
HRRL	High Rate Return Link
ICD	Interface Control Document
IP	Internet Protocol
IR	Interim Release
IRD	Interface Requirements Document
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IST	Instrument Support Terminal
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
kbps	kilobits per second
LAN	Local Area Network
LaRC	Langley Research Center
LIS	Lightning Imaging Sensor
LPS	Landsat Processing System
LRS	Low Rate System
LRRL	Low Rate Return Link
LRU	Lowest Replaceable Unit
LSM	Local System Management
LZPF	Level Zero Processing Facility
Mbps	megabits per second
MDM	Multiplex-Demultiplex
MDT	Mean Down Time
MOC	Mission Operations Center

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ACRONYMS

MODNET	Mission Operations Directorate Network
MRTT	Mission Readiness Test Team
MSFC	Marshall Space Flight Center
MSS	Message Switching System
MTPE	Mission To Planet Earth
MTTRS	Mean Time To Restore Service
MDM	Multiplexer
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NASCOP	Nascom Operations Procedures
NASDA	National Space Development Agency (of Japan)
NCC	Network Control Center
NESDIS	National Environmental Satellite, Data and Information Service
NJ	New Jersey
NMCC	Network Management Control Center
NMS	Network Management System
NNM	Network Node Manager
NOAA	National Oceanic and Atmospheric Administration
NOC	Network Operations Center
NOLAN	Nascom Operational Local Area Network
NSAP	Network Service Assurance Plan
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OSPF	Open Shortest Path First
PERT	Project Evaluation Review Technique
PSCN	Program Support Communications Network
RID	Review Item Disposition
RIP	Routing Information Protocol
RMA	Reliability, Maintainability, Availability
RMON	Remote Monitoring
RT	Real Time
RTM	Requirements and Traceability Management
SAR	Synthetic Aperture Radar
SAS	Statistical Analysis System
SCF	Science Computing Facility
SCS	Spacecraft Checkout Station
SDF	Software Development Facility
SDPF	Science Data Processing Facility

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ACRONYMS

SEF	Sustaining Engineering Facility
SEWP	Scientific and Engineering Workstation Package
SI&T	System Integration and Test
SMC	System Monitoring and Coordination Center
SNMP	Simple Network Management Protocol
SSIM	Spacecraft Simulator
STGT	Second TDRSS Ground Terminal
TBD	To Be Determined
TBR	To Be Reviewed
TDRSS	Tracking Data Relay Satellite System
TKSC	Tsukuba, Japan
TRMM	Tropical Rainfall Measurement Mission
TRR	Test Readiness Review
TSDIS	TRMM Science Data and Information System
V & V	Verification and Validation
V0	EOSDIS Version 0
VDS	Voice Distribution System
VFPA	Valley Forge, Pennsylvania
VSS	Voice Switching System
WFF	Wallops Flight Facility
WOTS	Wallops Orbital Tracking Station
WSC	White Sands Complex
WWW	World Wide Web
YLC	Yoshinobu Launch Complex (Japan)